SCIENTIFIC AMERICAN SUPPLEMENT. No. 1138

Scientific American, established 1845.
Scientific American Supplement, Vol. XLIV, No. 1138.

NEW YORK, OCTOBER 23, 1897.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

READING LESSON GIVEN BY A BLIND TEACHER.

BRUSH SHOP.

A LESSON IN NATURAL HISTORY.

## METHODS OF INSTRUCTING THE BLIND IN FRANCE.

## THE BRAILLE SCHOOL FOR THE BLIND AT SAINT MANDÉ.

WITH the aid of the Société d'Assistance pour les Aveugles that he had founded, M. Pephau, on the first of January, 1883, opened at Maisons Alfort the Braille School, which, first transferred to No. 152 Rue de Bagnolet, in Paris, was afterward definitely installed at No. 5 Rue Mongenot, at Saint Mandé, by the General Council of the Seine, which has made a departmental institution of it.

This school supplies a want that has long been felt by the blind. The child who is admitted to it does not simply receive a very thorough primary instruction, but is developed physically by gymnastic exercises in the open air; and he learns also to like manual labor in passing an hour or so every day in a shop provided for apprentices.

But what care and what abnegation does it not require for such instruction! Of the children taken directly by their parents to Rue Mongenot, how many have been led thither only after a genuine fight of the representatives of the school with the families? It is because a blind child yields a good revenue. No one better than he can draw looks of compassion and good sized coins from passers-by. His infirmity yields receipts. There are professional contractors who exploit him to the great profit of his poor parents. If he enters the Braille School, farewell to all this; the source of an easy revenue is cut off.

Under these conditions the work of the Braille School is not only that of instruction, but, what is doubly difficult, is also disciplinary and social. Its accomplishment requires great intelligence and patience, and especially a genuine goodness of heart and much compassion for human misery. The union of such qualities in all of Mr. Pephau's fellow laborers precisely characterizes the institution created by him, and they exhibit themselves to the visitor as soon as he has crossed the threshold of the school.

See in the corner of the yard that young woman seated upon a very low bench. To her right and left are two very young children of the maternal school recently annexed to the establishment. She is teaching them the Braille alphabet. In the Braille writing, the letters are formed of a combination of dots. The children have to get used to counting the number of these dots and conjecturing the arrangement in order to learn to read. The instructress passes the child's fingers over the page of hieroglyphics with untiring patience, while she plays with the little one and amuses it until she has taught it to find its way in this maze of dots.

The touch is the sense that it is most important to render acute in the blind. This is not all sufficient, however, for hearing, smell and taste have to come to its aid. The development of these senses has to be undertaken methodically and rationally. Before forming an opinion as to the nature and bulk of an object, the blind child has been surrounded with hundreds of elements of observation, and has been taught to remark the hardness, roughness or sonorousness of an object, and then its weight, temperature and dimensions.

In order to attain sufficient precision in the recognition of the things or beings that surround him, the child must therefore devote his senses to numerous preparatory exercises. This is the task of the instructresses. It is facilitated at the Braille School by M. Baldon, the director, who, putting his experience to profit, has grouped in one series of object lessons all the exercises capable of gradually making the development of the blind child's senses as perfect as possible. The study of lines, angles, surfaces and geometrical solids permits of learning the form of bodies by comparison. By familiarizing his hands and mind with various lengths (with sticks of 5, 10, 20, 30, 40 and 50 centimeters or of 1, 2 or 3 meters) and with spaces, the child is easily taught to estimate the dimensions of objects and also distances.

Through unremitting attention, knowing that many bodies have a special sonorousness or that the sonorousness varies according to the surroundings, the child succeeds in distinguishing the size of a room that he enters and the stature and age of the person who speaks to him. The voice, in fact, does not resound in the same way in a small room as in a large one, and does not impress the ear in the same manner coming from above or below.

To the blind everything has to be the subject of observations, such as the rolling of a carriage or of a street or railway car, the sound of a bell, the noise of a waterfall, the song of birds, the cries of animals, etc. Even his feet must furnish him with useful information as to the nature of the ground upon which they tread, whether it is macadamized, paved, etc. But, before the blind child has enough confidence in himself to mingle with life in general, or to participate in such acts of the latter as are capable of interesting him, how many patient lessons, how many wise counsels, and what ingenuity in the processes of teaching!

Nothing is more interesting than the spectacle of a class at the Braille School. To appreciate it, one should see with what rapidity and general accuracy the pupils answer the questions put to them by their mistress, such as those concerning the metrical system or natural history, for example. If a measure of capacity is put into their hands, they feel of it, weigh it with the hand, endeavor to determine the material by the rugosities of the surface and the density, and thrust their hand into it in order to ascertain its depth. If, in a lesson on natural history, any sort of an animal is placed before them, such as a starfish, mole, badger, squirrel, duck, etc., they pass their hands over its body in searching for the eyes, legs, teeth, and, in a word, the distinctive characters of each class and each animal. "This is a palmipede, madam. It has a wide bill; it is a duck," answers a pupil. "Strong legs, provided with sharp claws, long teeth directed forward, teeth sharp behind. It is a carnivorous animal, madam. It is a cat." "And this one?" "That is a rodent, a squirrel."

That a blind person can succeed in identifying an animal by feeling of its body is conceivable. But how he can indicate with precision upon a map or a globe such and such a country, such and such a river or such and such a town is not so easily explainable. In order to obtain such a result in the Braille School, the ordinary maps are replaced by maps in relief on which the principal towns, represented by copper tacks, constitute so many datum points. You can revolve the globe and ask the pupil at hazard to find a city of Europe or Asia, and he will pass his fingers over the surface and locate the places for you at once. In the same way, he will go through the streets of a plan of Paris from one point to another in designating them by name and in telling you what he sees therein, for the blind person says "see" for "touch." Another and very simple method of teaching the pupils of this school the configuration of countries has been found. This consists in putting at their disposal those wooden block maps called games of patience that children who can see amuse themselves with.

The results of such instruction, which have more than once amazed pedagogues, are due in great part to the excellence of the methods and to the personnel whose duty it is to employ them.

Certain natural dispositions of the blind for study merit notice. Although the privation of sight creates an evident inferiority, it nevertheless contributes toward increasing the faculties of reflection and reasoning. The blind pupil has an advantage over the one who can see. He is not distracted, but follows his thought or the instructress's explanation and demonstration, without being diverted therefrom (as is too often the case with pupils who have their sight) by insignificant external manifestations, such as the flight of an insect or the grimace of a companion.

Such concentration of judgment gives a visible imprint to the character of the blind, and likewise serves as a motive to the intervention of their educators. The blind pupil does not care much for play. It is necessary to make him love sports. One succeeds in doing this quite easily, and the spectacle is certainly picturesque in the yard of the Braille School at the hour of recess, with the boys playing leap frog or running without coming into collision, and the girls skipping the rope or dancing.

BASKET MAKING.

Being the issue of parents upon whom poverty has left its impress, the children admitted to the Braille School are mostly of unsound constitution. Frequent gymnastic exercises, either in the yard or in an adjoining gymnasium, contribute toward the physical development of the pupils. At the age of thirteen, the latter leave the primary school for the shop. This they are already slightly acquainted with, since manual labor is included in the programme of the primary school. What will they be taught? Simple trades, but such as will nevertheless gain for them the wherewithal to live upon in independence. Some will make brushes, others will do basketwork, others will cane chairs, and others again will make pearl flowers.

The manufacture of brushes is done in the first story. Boys and girls are occupied in this in the rooms situated to the right and left of a small central shop whence, through glazed windows, the foreman and his assistants can exercise continual surveillance. It is interesting to see with what prudent skill the blind operatives use the cutting instruments, the handling of which is reputed to be dangerous even to those who possess eyesight. The same observation is applicable to the basket workers, who cut, shape and scrape the osier with assurance and without ever injuring themselves. Just as there are boys only in the basket shop, so there are girls only in that in which objects of pearl are made.

The caning shop, which is situated upon the ground floor, is mixed. It receives apprentices of both sexes. In a portion of this hall, a few of the children are employed in the manufacture of straw chairs, and here the beginners at all trades try their hands. The apprentices and operatives are the object of the same attentive care on the part of the foremen and forewomen as that with which they are surrounded in school by the instructresses. The visitor experiences a true feeling of admiration before this beehive of industry where beings that had been seemingly destined to a life of ignorance are producing the wherewithal to assure them a tranquil and proud existence in the midst of a world from which an abyss seemed to separate them.—L'Illustration.

## THE DEVELOPMENT OF THE AMERICAN BLOOMING MILL.*

By RALPH CROOKER, Jr.

THE Bessemer and open hearth processes are the survivors of many attempts to produce a cheaper or better material than that produced by puddling.

When these new methods of working iron emerged from the wholly experimental stage and became accepted commercial facts, they found the iron and steel industry already in a highly developed state. The crucible steel process was then about as perfect as it is to-day; while the making of puddled iron, stimulated to the highest degree by the building of railroads—which it had made possible—had reached a point which it has since excelled but little, if any, in quality; although for some years afterward it continued to increase in quantity.

It was to the machinery prepared for the handling of these materials—crucible steel and wrought iron—that the first ingots of the new processes—at first almost exclusively Bessemer—came, to be worked into the shapes that afforded the best market for them, or which stood most in need of such improvement in quality as they offered.

In England, where the greater part of the early development of the Bessemer was done, the ingots were at once sent to the hammer, and submitted to the same treatment as the crucible steel. I am unable to find that any attempt was made to roll it direct from the ingot during the first few years of Bessemer practice; a fortunate circumstance, I think all will agree, who are familiar with the characteristics of that early steel. The product of an English Bessemer works at this time—the middle sixties—was so small—from one to two hundred tons per week—and relatively of so little importance in the large English and Continental works, that the need of machinery especially to care for it does not seem to have been felt. It was a very simple matter to add hammers as the product of the Bessemer works increased, which it did very rapidly; and this was the universal practice, persisted in until the forge department of some of the works attained tremendous proportions, one firm alone having seventy hammers in use before abandoning the system, and making little or no change except to strengthen them and increase the size from four to five, and then to seven and ten tons.

The first to undertake the improvement of this state of affairs was Mr. John Ramsbottom. He undertook to improve the hammer itself, and brought out his duplex hammer, which consisted of two hammer heads moving horizontally toward each other on rollers, the heads being actuated by a steam cylinder through links, the ingot worked upon being placed between the hammer heads, and moved in a direction at right angles with their motion.

Several of these were put in operation, but they do not

* A paper read before the regular September meeting of the Engineers' Society of Western Pennsylvania.

seem to have altogether accomplished their purpose, at least they do not seem to have suited Mr. Ramsbottom, for he shortly afterward introduced his cogging mill, which was one of several devices brought forward at about the same time by different inventors, and the only one of them, so far as I can ascertain, which was ever put in practical use.

This mill in its general features was so nearly like the later blooming mills that one wonders how he managed to miss it. It consisted of a pair of huge housings carrying a pair of arbors, to which were bolted segments of cast iron, forming grooves which went part way around the rolls. The two rolls were made to turn in unison by means of pinions keyed to their necks, and were driven, through very high gearing, by a small reversing engine. The top roll was counterbalanced by a small hydraulic cylinder in the window of the housing between the necks, an arrangement made possible by the great diameter of the rolls—over five feet—and the top roll was forced down by a wedge, driven between the top of the housing and the top box by a hydraulic cylinder, operating through a rack and pinion. The vertical movement of the top roll with this arrangement was, of course, very limited.

While Mr. Ramsbottom was busy trying to correct the faults of his duplex hammer, by building his cogging mill, others, who were using them, were wrestling with the same problem, which was forced upon them by the constantly increasing output of their Bessemer works; and the obvious method of rolling the ingots in the "top and bottom" rolls of their rail mills was tried by several, and with considerable success.

With the English rail mills it was an easy matter to do this, and it may be well here to call attention to the distinct difference in practice existing between the English and American mills of the period (1867), a difference which had come about during the preceding ten years.

Up to 1857 the mills for heavy work—those in America being nearly all rail mills—were the same in both countries, two-high and non-reversing, the piece being returned over the top roll. In this year Mr. John Fritz put in use his hanging guide, which made three-high rail mills possible, and within a few years all the American mills were made three-high.

This was not the case in England, however, where efforts were made to improve their two-high mills by reversing the motion of the rolls between passes, so as to work the piece through the rolls in both directions, the means adopted being five gears and a clutch—many kinds of which were used—and later, reversing engines.

So at the latter end of the decade between 1860 and 1870, the universal practice in America was three-high and in England reversing two-high mills.

It is not surprising, therefore, that in its first blooming mills each country should have followed the form of mill prevailing at home; but so fixed was the difference of opinion as to their respective merits that each country stuck to its own, without a waver, for the next ten years, and without, seemingly, caring to know much about the other.

When it was shown that ingots could be bloomed successfully on the "top and bottom" rolls, larger reversing mills, built especially for the purpose, quickly followed, and several were in use at the end of the decade (1860–1870), although hammering was continued in some works for many years.

America did not begin its modern steel making as soon as England and Europe, nor did it advance so rapidly for some time after it began. There were several reasons for this. We were busy with a great war, which absorbed all our energies, most of our money and many lives, costs of installation and production generally were much greater, and uncertainty and dispute as to patent rights made it hazardous to enter upon such undertakings, so it was 1864 when the first ingots were made at Wyandotte, and they, like those produced abroad at the same time, were hammered. Troy, Pennsylvania, Freedom and Cleveland, the only other producers of Bessemer steel in that decade, all used the hammer for blooming.

It was at the beginning of the decade 1870–1880, when the production of Bessemer steel ingots in America had reached 40,000 tons for the year, that the shortcomings of the hammer began to be seriously felt, and the necessity of building blooming mills forced itself upon the steel makers of this country, and the first works to put a blooming mill in operation was Troy, which rolled its first ingots in January, 1871. This mill, following the general practice of American rolling mills, was a three-high mill, being the first three-high blooming mill in the world, as well as the first blooming mill in the United States. Its top and bottom rolls were fixed, the middle roll was carried in a pair of forged steel bolsters and was moved up or down after each pass by four screws driven from the main engine shaft by a belt, shafting and worm gearing controlled by a belt-driven reversing clutch. The tables on both sides of the rolls were raised and lowered together by hydraulic power. The top of the tables was made up of loose rollers, spaced closely, and on these the two rail ingots were pushed straight for the passes and into the rolls with bars and turned with tongs.

A LESSON IN GEOGRAPHY AT THE BRAILLE SCHOOL.

About six months later (July 10, 1871) the Cambria Iron Company put in operation a mill designed by Mr. George Fritz, which had much the same influence on American blooming mills as his brother's earlier invention had had on American rail mills, and fixed the type of mill in almost exclusive use for the decade. This, also, was a three-high mill; but it differed from the Troy mill in having its middle roll stationary, while the top and bottom rolls were movable. The top roll was counterbalanced, and the top and bottom rolls were moved toward the middle one between passes by screws acting together; they were, therefore, only obliged to make the full travel when opening to receive the ingot for the first pass.

The important feature, however, was the tables. These raised and lowered together by hydraulic power, and the tops were composed of rollers arranged to be driven from the main engine by gearing controlled by friction clutches. Combined with this was a manipulator, which consisted of a small car beneath the table with prongs on top of it, extending up through the table rollers when the table was down; this car was moved transversely to any desired position under the table by a hydraulic cylinder, and by lowering the ingot on to the prongs it could be turned, or by pushing the prongs against the side of the ingot it could be moved from pass to pass. This mill was a notable success.

The next year (1872) the Cleveland Rolling Mill Company built a blooming mill which deserves mention as the first reversing blooming mill built in this country and also because it was the only one of its type ever constructed here. It was a clutch reversing mill, and all the auxiliaries, tables, shears and shear tables, were driven from the train engine. As at first put down, it reversed with a three-gear clutch; this was afterward changed to the five-gear system. In both cases friction clutches were used, and I believe that no blooming mill has ever been built here that reversed with crab clutches. English practice largely influenced the design of this mill, and at that time the superiority of reversing engines was not established—although it surely was shortly afterward; but that friction clutches were better than crab clutches for reversing was settled. The engineering periodicals and the records of engineering societies for some five or six years, about 1870, are full of illustrations and discussions as to the relative merits of the many devices proposed to overcome the glaring faults of the crab, and are interesting history.

These three mills (Troy, Cambria and Cleveland) may be grouped as the pioneer American blooming mills; but the Fritz mill only needs further attention, the others having had no influence whatever on the design of later mills.

If the manufacture of Bessemer steel in America made slow progress in the decade 1860–1870, it quite made up for it in the first half of the next, eight large works being built on much improved plans. These were all intended for the manufacture of rails, and hardly any other outlet for their product was looked for or expected, the power of new railroad enterprises to absorb the product seeming, at the time, to be almost limitless, while the inferior quality of much of the early steel still cast a deep shadow of suspicion on its reliability for other purposes.

For blooming ingots, of the size then made for rails, it was and is still difficult to improve on the Fritz mill; the size of the ingots not requiring excessive length of tables, and the large section of the finished bloom made it possible to do the work on short rolls of comparatively small diameter.

Under these conditions it is easy to understand why nearly all of these eight works, built between 1871 and 1876, put in Fritz blooming mills, and no other kind of mill had a trial until these conditions changed.

As these mills followed each other in rapid succession, each was an attempt to improve upon its predecessors; but the improvements were entirely confined to minor details. Driving the tables by independent power succeeded various methods of driving from the main engines, operating the table rollers automatically by V friction wheels, engaging when the tables were in either the highest or lowest position, came into use and was followed by a positive drive by means of gears, lazy tongs and reversing engines; the rolls, however, continued to be movable.

The great expansion of the Bessemer steel rail business between 1871 and 1876 was followed by an equally great depression in consequence of the business panic of 1873, and during the last half of the decade very little was done in new Bessemer construction, the efforts of the steel makers being entirely directed toward economical production, and it was these efforts which led to the first departure from what had come to be distinctly recognized as the American blooming mill.

The familiar method of increasing the tonnage was the one almost universally adopted to bring about the desired result, and so successful were the managers of the converting departments in this direction that the product of vessels soon exceeded the capacity of the casting pits to handle it, planned, as they had been, for the work of some years earlier.

Faced with this state of affairs, the Cambria Iron Company, in 1878, determined on a radical departure from the prevailing pit practice, which involved the making of ingots much larger than those in common use, and to care for these they put in a mill which deserves attention, being the first blooming mill in the country reversing with engines, and unique in other respects.

When the Freedom works were built in 1868, a plate mill had been imported from England with a reversing engine, said at the time to be "the best of its class yet produced." It was this mill and engine, with blooming rolls substituted for the original plate rolls, which the Cambria Iron Company utilized to work the large ingots. It was, therefore, an English mill; but the tables, which constituted its chief title to distinction, were American, having been designed by the late Mr. Daniel N. Jones. These consisted of large rectangular frames carrying the gudgeons of loose rollers, the bodies of which rested on solid tracks. These frames, with the rollers, were moved to and from the rolls, through a short distance, by hydraulic cylinders. It will thus be seen that when the table, with the ingot resting on the rollers, was pushed by the cylinder toward the mill, the ingot, moving twice as fast,

projected over the end of the table and into the rolls. With this table was combined a manipulator which was very simple and efficient. It consisted of two hydraulic cylinders; one mounted on each side of the table, but independent of it, with the piston rods extending over it and carrying heads so shaped that by forcing them against the ingot it could be turned or moved from one pass to another. A useful feature of this manipulator was that by stopping the mill with the piece in the rolls a crooked bloom could be straightened by forcing one of the heads against it, an important advantage when ingots have been unevenly heated.

The screws of this mill were operated by a small steam engine, and the top roll was counterbalanced by hydraulic pressure.

It is a singular fact in connection with this mill, with a manipulator in successful use, that none of the numerous reversing mills built were equipped with manipulators of any kind for seven years afterward.

While the blooming mills built up to this time had all been in connection with Bessemer works and with a view to rail manufacture, the open hearth process had been steadily developed since 1870, and it is to be noted that from the time when the building of Bessemer works ceased in 1875 until the phenomenal development of new undertakings following the business revival of 1879-80, the building of open hearths was about the only new work done, and the product was at first almost as exclusively devoted to plates as the Bessemer was to rails. The hard times of the last half of the decade forced the Bessemer makers to try to dispose of a part of their steel by rolling their blooms into billets on other mills; at the same time the high quality of the open hearth metal had created a considerable demand for it; but the open hearth makers labored under great disadvantages in getting their material into marketable shape, being compelled to cast small ingots and roll them on the larger bar mills. The Fritz patents had passed into the hands of an exclusive corporation, and the small size of the open hearth works, coupled with the high cost of a blooming mill, made the open hearth people hesitate before putting in so much capital to do so little work.

At last, in 1879, Shoenberger & Company put in operation a reversing blooming mill, in connection with their open hearth furnaces, which was the first to be built except at a Bessemer plant, and also the first to be devoted entirely to the general trade in blooms, billets and slabs.

In this mill the grooves in the rolls were of varying depth, the screws were worked by power from the shears engine through a Hill clutch, and the tables, made of I beam frames and cast iron rollers, were driven and reversed by the train engine direct, through belts. The rolls were driven by a pair of reversing engines which had previously been used on a gunboat, no reversing rolling mill engines having then been made in this country. This mill is of interest, as the experience gained from it was embodied in the design of the one erected at Homestead two years later, thus having a decided bearing on the development of our modern mills, and, furthermore, because on it were made the first four inch billets rolled direct on a blooming mill.

The same reasons which led to the building of the Shoenberger mill caused other open hearth makers to do the same; but so firmly fixed was the superiority of the three-high mill over the reversing mill, in most minds, that the latter received but little consideration. To use three-high mills, however, the Fritz patents must be avoided, and, with this object in view, two mills were built, one for Naylor & Company for billets, and one for the Springfield Iron Company for rail blooms. The peculiarity of these mills was the table arrangement. At the back of the rolls was a table of loose rollers, lifted directly by a jack; on the front side were ordinary hooks, which were raised and lowered by the motion of the back table, but through less distance. A fixed driven roller was placed over the back table in such a way that when the table was raised the ingot was forced against it and thus carried into the rolls.

Another mill should here be spoken of as illustrating the expedients to which steel works managers resorted when the Fritz patents could not be used and before mills reversing with engines were accepted as good practice in this country. It was put in at the Union Works at about the beginning of 1880, and was reversed by the surface friction of large wheels with very broad faces (twenty feet and eight feet in diameter, I think) which were forced in contact by means of a hydraulic cylinder and levers. This mill was afterward replaced by a modern three-high mill, and should be remembered only as taking the place of the last hammers in the business, and as being the last attempt at reversing in any other way than by engines.

With the beginning of the decade 1880-1890 came great changes in the business conditions affecting the steel industry, and these were quickly reflected in repairs, improvements and additions to existing plants and the starting of new enterprises. The tremendous business expansion which began late in 1879 continued through 1880, 1881 and 1882, and the demand for steel works products, especially rails, was unprecedented. This demand came upon works many of which, during the preceding five years, had been run with the least possible expenditure for repairs, and were now driven to the utmost capacity. This usage of machinery quickly made necessary the replacement of several of the earlier blooming mills, while some firms added complete new plants.

In these renewals and extensions the influence of the Cambria practice of large ingots is clearly shown, all the new mills being made larger and stronger, while two mills, a three-high at Bethlehem, about 1884, and a reversing mill at Cambria, in 1885, following the decided tendency of the time, were made forty-eight inches in diameter. The conclusion seems to have been reached, however, that equally good results may be obtained from somewhat smaller mills, and none have since been set up of over forty inches.

With this group of new mills the three-high mill reached a fixed standard which we may call the modern three-high blooming mill, the first one embodying all its characteristics having been put down at Chattanooga in 1878, and since this time no appreciable change has taken place. In these mills the rolls are all fixed, the tables are raised and lowered by a horizontal cylinder connected with L cranks and links, and the table rollers are driven by an independent reversing engine through gears carried by a lazy tongs.

How thoroughly efficient this kind of mill has proved itself for the making of rail blooms is shown by the fact that in all the new work intended for rail making, in the decade which we are now considering, all but two were of this description—one at Scranton and the other at the Cambria Works. In this latter case the necessity of making various sizes for other purposes than rails largely governed the choice, and it is of interest that this mill replaced the original Fritz mill.

Of the many new enterprises inaugurated during this period, the works erected at Homestead in 1881 by the Pittsburg Bessemer Steel Company, from the plans of Mr. James Hemphill, claim particular attention. This plant, the beginning of the great establishment now located there, was the first Bessemer works especially built to manufacture steel for other purposes than rails; it was also the first to be put in operation after the expiration of the essential Bessemer patent, and in its construction a number of patents, supposed by many to be indispensable, had to be avoided.

In designing the blooming mill the experience gained in the Shoenberger mill—alluded to earlier in this paper—was largely availed of, and several features afterward generally used in American reversing blooming mills were introduced. The mill was driven by the first American reversing engine intended for rolling mill use; the rolls were made with all the grooves of equal depth, thus permitting the adoption of straight table rollers and the making of many sizes on one pair of rolls, and the roll screws were worked by a hydraulic cylinder through a rack and multiplying gear. The tables were constructed with I beam frames and the table rollers were driven by an independent reversing engine, the ingot being handled and turned on the tables by ordinary hooks hung from above, and tongs.

This mill proved itself very efficient, and during the following years many mills of similar character were built, the building of blooming mills receiving great impetus by reason of the change of the material used in cut nails from iron to steel and by the increasing demand for Bessemer billets, which followed rapidly when once they were fairly on the market.

In these mills, about the only changes from the Homestead mill was the substitution of heavy cast iron table frames for the I beam construction, and a simplifying of the table driving gearing.

It was on one of these mills, at the Spang Steel Works in 1885, that the first manipulator after the Cambria one of 1878 was tried, and after that they came slowly into use.

Another mill which should be mentioned in connection with the new enterprises of this time is one which was put to work at Scranton for making rail blooms, in 1883. This mill, with its engine, was imported from England, and is the only complete mill ever brought from there. It was a good sample of the typical English mill of the time; very heavy and with great power. The tables consisted of loose rollers, their necks running freely on rails, and the ingots were handled on these with tongs. This table arrangement, which was never copied by American mills, was replaced some years later by a modern driven roller table. This mill seems to have had some influence in calling attention to what could be done by increasing the engine power of our mills, which was emphasized later by the work of the Sparrow's Point mill.

With the decreasing requirements for rails in this decade, and the ever-increasing demand for steel for other purposes, the three-high mill, except for replacements in rail works, received but little attention. It seemed to be accepted, as fact, that the two-high mill was best where a wide range of work was to be done. It is for this reason that a mill put down at the Otis works, at Cleveland, to combine the advantages of both systems, requires description, being the last of the modifications of the three-high mill.

In this mill the bottom roll was fixed, the top roll was counterbalanced and worked with screws in the same manner as the top roll of a two-high mill, while the middle roll was thrown up and down between passes as in a three-high plate mill; the collars being made extra wide, to support the middle roll, which rested against them when working. The Fritz tables of this mill were thirty feet long, and the only ones of that type ever fitted to a mill for general bloom and billet work.

With the beginning of the present decade practice had become so established that but one mill may be considered as particularly departing from it. This is the Sparrow's Point mill, which is the only thoroughly American reversing mill which has yet been intended exclusively for rail blooms, and is noticeable chiefly for the great power of its engines, which demonstrated the capacity of this form of mill when properly engined; and since the installation there has been a marked increase in the power provided for mills of its class.

The three-high blooming mill reached its highest development at about the time that the two-high mill began its career, and within ten years of its inception; and since that time their number has diminished rather than increased, partly because of a reduction in the number of rail-making establishments, in which field it has maintained its pre-eminence, and shows how thoroughly adapted it was to the purpose for which it was intended.

With the two-high mill it is a story of progressive development for nearly twenty years. We did not begin with this kind of mills until it had been in use abroad for many years, but we availed ourselves little of foreign experience and followed lines of our own, improving and altering our original designs.

The first table frames made of I beams were displaced by cast iron with the bearings cast on; these were followed by built up wrought-iron and cast-iron frames with separate bearings; the present table frame being a substantial cast-iron bed plate with the bearings bolted on, and in some instances water-cooled.

Table rollers of cast iron with wrought axles cast in were quickly abandoned for the wrought-iron pipe roller in general use on the three-high mills; then came the steel casting with the necks cast on, and to-day the preference is divided between these and a roller made of a cast-iron body fitted with a forged axle.

The driving of the table rollers began by taking power from the main engine, which was soon changed to the use of a separate engine driving both tables together through a countershaft; and finally the countershaft has been done away with, an engine coupled directly to the line shaft being used for each table. At the same time there has been a steady improvement in the table gearing. In the earlier mills the rollers were divided into groups driven by spurs and idlers; the number of these has been gradually reduced until each separate roller is now driven by a miter gear, and there is not a single intermediate gear or countershaft of any kind in the best mills.

Manipulators, after a few trials, superseded the old-fashioned hooks and tongs, and since 1890 have been in general use. In this matter alone there seems still to be a difference of opinion, and some half dozen kinds have their advocates.

In the mill itself, we have finally widened the windows of the housings so that the rolls may be changed through them; and we now generally use hydraulic counterbalancing for the top roll—methods which have prevailed in other countries from the beginning, but which we reached rather by evolution than by imitation. For working the roll screws there has been but slight change since hydraulic power took the place of belts and engines, although electric motors are used on some mills requiring extraordinary lift to the top roll.

The early mills were driven by engines with gearing of three or four to one: these ratios have been steadily cut down until gearing has been abandoned, and the latest mills are connected directly to the crank shaft.

It seems as though the work of simplifying the two-high mill has about reached its limit, and, like the three-high mill of fifteen years ago, there is little room left for further improvement.

THE LOUITON FLOAT.

## THE LOUITON FLOAT FOR SWIMMERS.

The Louiton float, which is represented in the accompanying engravings, consists of a long bag made of sheet rubber, and which, when inflated, assumes a cylindrical form with conical extremities. At each end of the float there is a long leather attachment. Each conical extremity terminates in a narrow tubulure, which is closed by a wooden plug. This float is inflated with the mouth, and quite rapidly, too; say in less than a minute. It is afterward wound about the body, as shown in the figures. The dimensions of the apparatus are as follows: Cylindrical length, 3 meters; diameter, 5 centimeters; length of the conical extremities, 5 centimeters; internal diameter at the summit, 5 centimeters; length of tubulures, 4 centimeters, and

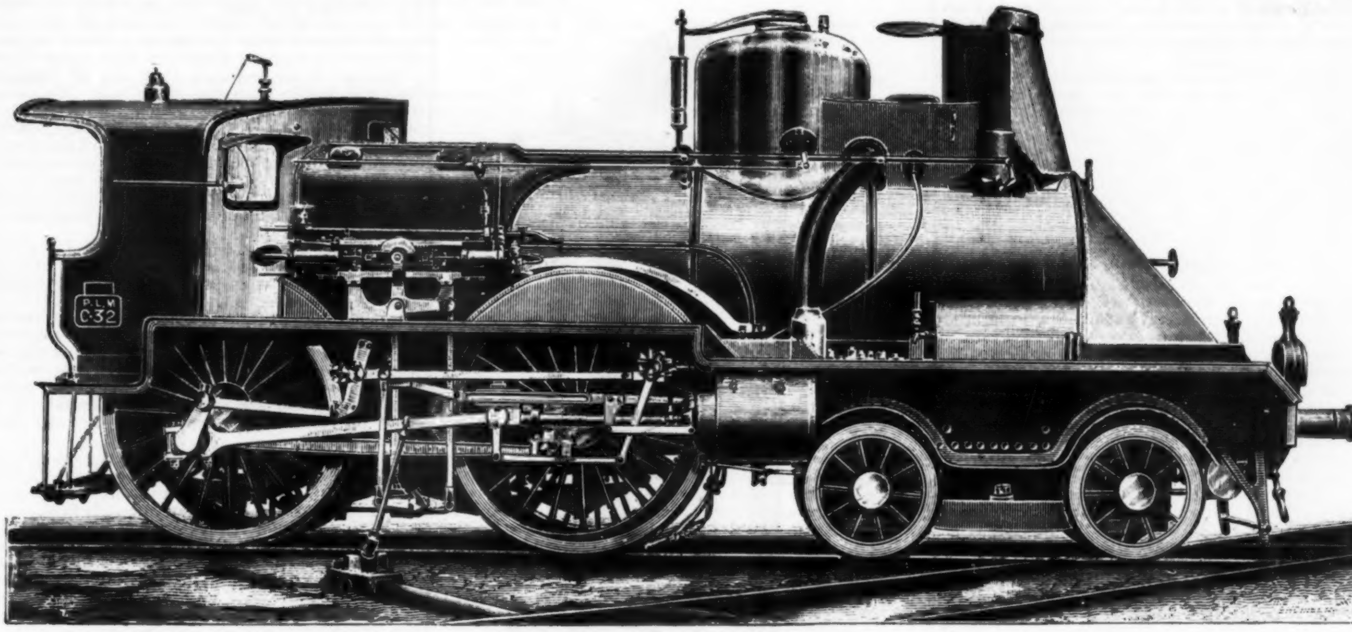
the diameter the same as that of the conical extremity. The thickness of the bag, which is uniform, is one millimeter. The total weight is exactly 520 grammes.

This float for swimming may, if need be, be made longer or shorter and have capacities of 10 and even 15 cubic decimeters. The thickness of one millimeter, although sufficient, may be doubled, if necessary. The plugs are of hard, turned wood, and taper at one extremity. In order to insert them into the tubulure, they must be wet and introduced with a screwing motion. This float is very useful. It permits any one to learn how to swim, and assures rest and safety to bathers, swimmers and others.

Experiments have shown various advantages: It is very simple, very flexible, quite strong and light, and may be easily carried, be quickly repaired and easily placed upon the body. It does not interfere with respiration, the wearing of it is attended with no inconvenience, and those who have tried it agree in the statement that it is very practical and may be recommended to swimming schools.—La Nature.

## A NEW FRENCH LOCOMOTIVE.

THE remarkable contour of the locomotive we illustrate on this page needs no comment. From time to time persons forget that the end friction of elongated bodies moving at high velocities is practically negligible when compared with the side friction, and attempt to reduce resistance by providing the body with a pointed beak or prow, even at the expense of increased surface. It is true that projectiles are pointed at the leading extremity, but it has been shown by experiment that the gain in velocity from so doing is only slight. The projectile, however, flies more steadily, and it is therefore pointed. An elongated projectile with a hemispherical end, but tapering toward the rear extremity, is about as good for flight as any. The porpoise very closely follows this shape, and perhaps the great speed attained by this animal is dependent in large measure upon it. The locomotive is the first of forty constructed to the designs of M. Ch. Baudry, for the Compagnie Paris-Lyons-Méditerranée. It is compound, having two low pressure and two high pressure cylinders, the latter being outside the frames, and the steam which is conducted to the chest by the exterior tubes—one of which is seen — is distributed by Walschaert's valve gear. The low pressure cylinders beneath the boilers are, for the sake of saving room and labor, provided with Gooch link motion. There are two entirely independent reversing gears. A large number of experiments has been made with several of these engines, but more with a view to testing the value of different points of cut-off in the high or low pressure cylinders than for the attainment of very high speeds, no very fast running having so far been attained with them.—The Engineer.



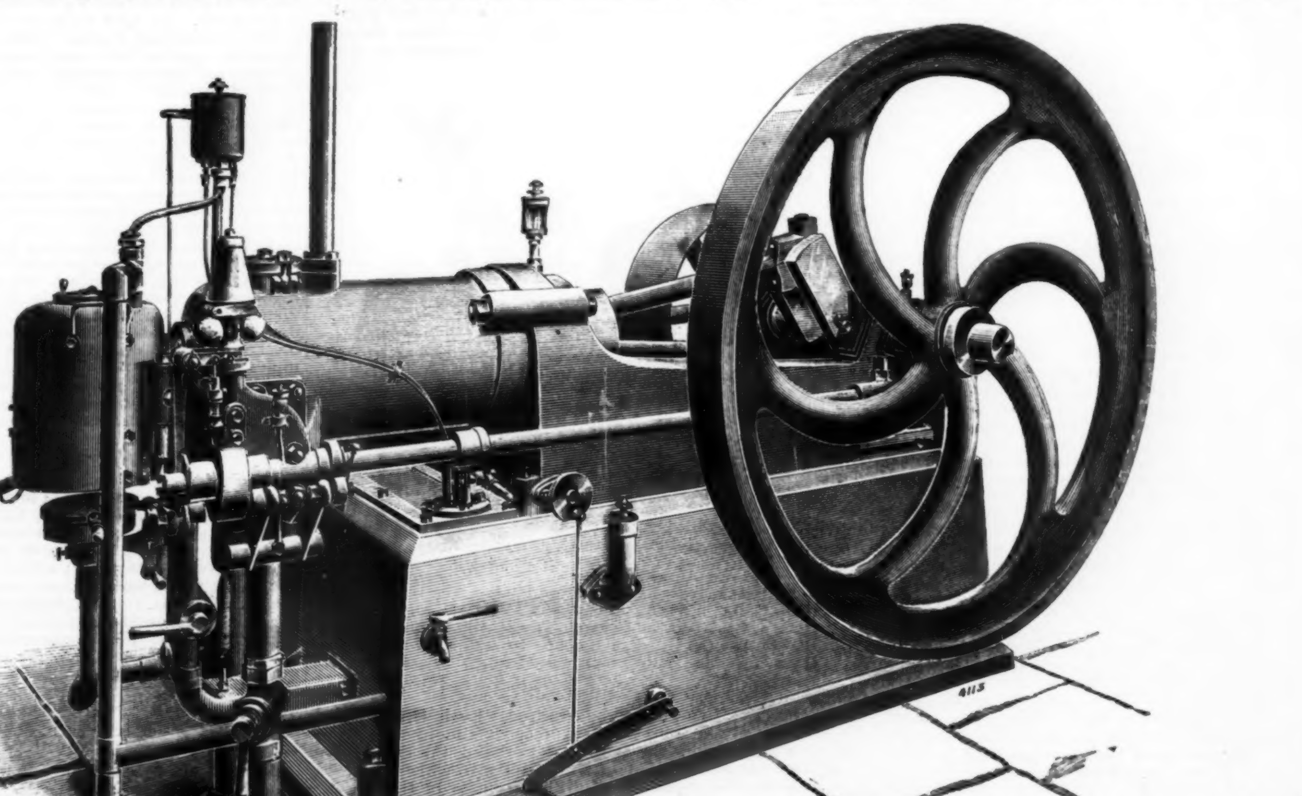

EXPRESS LOCOMOTIVE, PARIS-LYONS-MEDITERRANEAN RAILWAY.

## THE "RUSTON" OIL ENGINE.

THE illustration will give a general idea of the design and arrangement of parts of the oil engine manufactured by Messrs. Ruston, Proctor & Company, Limited, Lincoln, one of which was exhibited on their stand, No. 107, at the Royal Show, Manchester, driving a dynamo and supplying the current to the "Royce" motors and machines on the adjoining stand occupied by Messrs. Royce & Company, Manchester.

There has been in the past, and there still remains, much prejudice against oil engines which ignite their charges automatically by the evolved heat of combustion, but the fault has not been in the principle of automatic ignition, but in the means which makers have adopted up to the present to produce it. In the "Ruston" engine this extremely convenient method of working is so perfectly arranged that the engine is able to run and sustain its igniting temperature equally wel under all conditions of load, and has actually been run unloaded for three and a half hours under precisely the same conditions as when working with the full load. Messrs. Ruston, Proctor & Company inform us that during all the experiments, which have been very exhaustive, they have not known this engine to miss an ignition or to "back fire," as the objectionable explosion in the exhaust due to the missing fire is termed.

The engine works on the usual four-stroke cycle, and in governing cuts out such charges as are not required. By tracing the oil in its passage through the engine the working will be more clearly understood. The oil is stored in the base plate of the engine in a tank of sufficient capacity for a day's run at full power, this tank being arranged with convenient filling and drawing arrangements, both of which can be seen in the illustration. From the storage tank the oil is elevated by a single pump, which works constantly, to the cistern above the engine; this, being arranged with an overflow, is kept at a constant level. From the cistern the



RUSTON, PROCTOR & CO.'S OIL ENGINE.

petroleum is measured out in exactly equal amounts for each charge by a measuring device which can be changed, without stopping the engine, to suit different varieties of petroleum. The measuring apparatus delivers the oil charge at the right time down a tube leading to the vaporizer through the bottom of cistern.

The vaporizer itself is a spiral passage surrounded by an extension of the combustion chamber in open communication with the cylinder, the vaporizer receiving sufficient heat from the explosion within the extension of the combustion chamber to perfectly vaporize the oil charge. The petroleum is drawn through the vaporizer at atmospheric pressure, being followed and swept through the vaporizer passages by a current of air which insures the whole of each charge being delivered to the engine.

Upon the same extension of the combustion chamber, mentioned above, a simple cast iron ignition tube is placed, which, after heating up at starting, is kept at a dull red heat by the explosion within it. The ignition tube and passages surrounding the vaporizer and leading to the combustion chamber are so arranged that the products of combustion are cleared out and mixed with each incoming charge, this arrangement entirely preventing the carbon deposit which collects in the combustion chambers of so many oil engines.

The lamp is of the simplest construction, consisting of two pieces of cast iron, a dish and a cover, with an indestructible wick, by means of which the petroleum is lighted, obviating the necessity of putting in lighted waste or other makeshift, an uncleanly means of starting the lamp. A small fan, with a convenient treadle driving arrangement, feeds a blast of air to the lamp, which holds just sufficient oil to heat the vaporizer and igniter to the right temperature, and gives a number of fierce and distinct flames meeting together upon the ignition tube and vaporizer, enabling the preliminary heating to be accomplished in six or seven minutes. The engine can, therefore, be started and at work inside of ten minutes from entering the engine room.

The vaporizer and igniter are inclosed in one common cover provided with ventilating arrangements, by means of which the temperature of the vaporizer can be regulated should circumstances require it, though it is found this rarely needs adjustment, since the temperature is sufficiently sustained under all circumstances, and premature ignition is prevented by the amount of mechanical movement to be accomplished by the flame in traveling from the igniter to the main portion of the charge.

The convenience, safety and freedom from smell in having no lights which are supposed to burn constantly, but which frequently go out, either being blown out or stopped by dirt clogging up the fine holes necessary in such lamps, will be readily understood and appreciated. The vaporizer is never red hot or anything approaching it, being kept at a very moderate temperature, the igniter alone being so arranged that it approaches to a red heat.

The whole engine is extremely simple, easily started, and requires practically no attention. Where access to valves may at times be necessary or advisable metallic joints and convenient covers are arranged which can be quickly removed, so that every working part of the engine can be taken out, examined and replaced in a few minutes. As to the consumption of oil, the makers state that they have found the oil used per brake horse power per hour to be less than three-quarters of a pint of common Russian petroleum under suitable conditions and load in the medium and larger sizes, the smaller ones using a little more.

The engine can be arranged for use with any commercial petroleum of specific gravity from 0·795 and upward with very trifling changes, and the same oil is used in the lamp at starting as that burned in the engine. Messrs. Ruston, Proctor & Company are prepared to manufacture these engines in any size up to twenty brake horse power, and to supply similar engines to work with coal gas.—Engineering.

[Continued from SUPPLEMENT, No. 1137, page 18169.]

## PERPETUAL MOTION.—VII.*

FIG. 29 is a diagram sent us by Mr. William B. Cooper, of Philadelphia, who writes as follows in regard to it:

"Having seen in a previous issue a diagram of an attempt at perpetual motion, by H. Leonhart, I send you the inclosed diagram and description, which appears to me to correct the errors in his. The diagram represents an upright tank, through which passes a number of floats connected by a band of elastic rubber attached to their ends, leaving just enough space between them to secure action on each side by the water. They are each of the same weight as an equal bulk of water at the surface, therefore the upper one in the tank has no comparative weight. The next lower one has a unit of upward force equal to the condensation of its bulk of water, and so on, each adding a unit to the upward tendency, until we come to the last, the pressure on which is altogether downward to the amount of the entire column of water; but we already have a number of opposing upward forces, and when we look on the other side and see the thirteen active weights, it seems clear that there will be a large surplus weight, over and above the opposing weight and the friction of the rollers and upper wheel.

"Of course mercury or any other liquid could be substituted in place of water.

"If you can, by the inclosed rough diagram and description, comprehend my meaning, I would consider it a special favor if you would point out the error, if any."

The mistake of this invention is in supposing the upward pressure of the floats, added to the weight of the floats outside the tank, will more than equal the weight of a water column having a base equal to the lower side of one of the floats, and a height equal to the depth of the tank. If the floats be made of material more compressible than water, they would tend to sink rather than rise in the tank, but if made of material less compressible, the amount of upward force which could be obtained by their compression would be far less than the weight of water in the interstices between the floats. The downward effective pressure on the lower float in the tank would be the difference between this buoyancy and the weight of water in the interstices between the floats. The weight of the floats outside the tank is exactly balanced by the downward pressure of a bulk of water equal to that displaced by the floats in the tank, therefore if any motion should take place at all, it would be in an opposite direction from that expected, and would only continue till enough water had passed out of the bottom of the tank to bring the parts of the machine in exact balance.

We this week conclude our series of articles upon perpetual motion with an illustration of a machine,

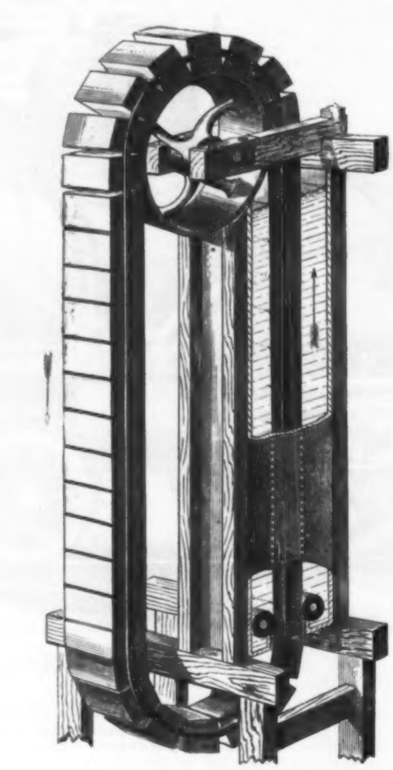


FIG. 29.

invented by a Canadian inventor, and a couple of letters upon the subject, lately received.

Fig. 30 is the device above referred to. It consists of a cylinder containing a fluid, with two or more weighted rods passing through stuffing boxes in the shell. To the middle of each of these rods is fixed a ball of cork which is expected to rise to the upper side of the cylinder whenever the revolution thereof brings it a little below the axis of the cylinder. In thus rising, it will carry the upper weight away from the center and bring the lower end toward the center, so that it is thought the center of gravity of cylinder arms, corks and metallic balls will be kept constantly on one side of a geometrical center, and constant revolution will result. The fact is, however, that the center of gravity will remain always in a perpendicular drawn through the axis, and, consequently, the expectations of the

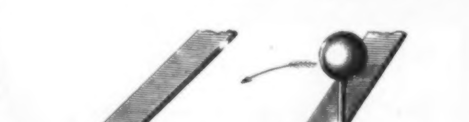


FIG. 30.

inventor will never be realized. Even if the movement of the arms expected to occur should take place when the cylinder is turned by hand, the decrease of weight on that side of the cylinder to which the cork would rise, caused by the displacement of the heavier fluid, and the increase of weight on the opposite side, caused by the displacement of the cork, would counterbalance the leverage of the weighted arms, and so the exact balance of the machine would remain undisturbed.

MESSRS. EDITORS: This communication is especially designed for the benefit of those who still believe the perpetual motion of machinery possible. Let it be granted that the terms weight and force are synonymous, i. e., twenty pounds of weight will require a force precisely equal to the force of its own pressure to sustain it, or neutralize that pressure. For example: If a twenty pound weight be placed upon a scale, and a hand be placed upon the opposite scale, the force applied by the hand must equal twenty pounds to exactly balance the twenty pounds.

So far we only affirm what every schoolboy is aware of.

Keeping strong hold upon this self-evident fact, we may next affirm that each twenty pounds is at an equal distance from the center pin or fulcrum of the beam. Observe also this additional fact. If either weight be depressed, the opposite one will rise at the same speed and through the same distance which the other has fallen; i. e., equal weights will balance each other, at equal distances from a common point of support, and will move in opposite directions with equal velocities.

Suppose it be required that one of these weights shall rise faster than the other falls. To accomplish this, we must remove it further from the fulcrum or point of support. Observe that a scale beam corresponds to the diameter of a circle, and the arms to the opposite radii of the circle. To the unscientific, these self-evident definitions may appear puerile; but let them reflect that the grandest theorems of scientific investigation wholly depend upon a recognition of self-evident truths.

Returning again to what was proposed, viz., to cause weights at the extremities of a lever to move at unequal velocity, we find that to do so they must describe arcs of different circles, as the radii are unequal.

But in removing one weight farther from the fulcrum than its opposite we destroy the balance; for example, suppose its distance to be double that of the other, it will now move with double velocity, but will require first double weight or force at the opposite end to balance it; in other words, "all that is gained in velocity must be replaced in force at the opposite end of the beam."

The converse of this is true; i. e., we may cause a weight to raise a greater, as already shown, but if we raise forty pounds with twenty, we only raise it half the distance which the twenty pounds falls.

The above being the essence of the "law of virtual velocity," needs only to be comprehended to entirely explode all possible theories of perpetual motion.

Every attempt to produce a self-moving machine has been in open defiance to the co-ordinated relations of force and motion, and any man who comprehends this law of velocity will no sooner attempt to solve the problem of perpetual motion than to climb upon his own shoulders as a higher point of observation.

I do not propose to exhaust the numerous theories in support of the fallacy, but will analyze a few, serving as a death knell to all.

Before attempting this, let us remark that, in the search for an impossibility, so many valuable and practical certainties have been demonstrated that perhaps no time has absolutely been thrown away, for as alchemy has fostered and developed chemistry, so has the search after perpetual motion taught how to apply force through complicated machinery, and thus through unsought channels has knowledge and civilization flowed all over the world.

A favorite device of the "perpetualists" is one which proposes to employ an overshot water wheel, that shall pump or convey the water back to a reservoir as fast as it comes out. To accomplish this it only becomes necessary that all the water shall move in equal volume or weight and equal velocity in a given circle, or at opposite ends of the scale beam. A simple recognition of the principle laid down at the beginning of this article demonstrates that this is absurd.

The supporters of this specifies of nonsense occasionally propose to lift this water above the highest point of the circle. As this supposes the less to exceed the greater, it does not require refutation. The foregoing reasoning applies with equal force to all combinations of tubes and endless chains, belts, cups, etc., proposing finally to act upon a given circle and to be lifted back to their proper positions to continuously act upon a greater circle, or longer set of levers. These simple facts set forth, that equals can only balance equals when acting oppositely at equal distances, completely upset all possible theories of perpetual motion. But a few days since, one of this class of enthusiasts called upon the writer with a rude drawing, in which appears some half dozen geared wheels with about an equal number of mystical appearing levers, by which he exultingly proposed to propel a first class steamship across the Atlantic, by employing one man at a crank turning a geared wheel two feet in diameter. Of course, I dissented, but his faith was sublime; and he left, evidently disgusted with my shortsighted ignorance and mechanical bigotry. And so it will continue until minds of this class pause and observe a few simple and obvious truths, which, clearly recognized, make the theory of perpetual motion to fade like "the baseless fabric of a vision, leaving not a rack behind."

I. D. J. SWEET.

A humorous correspondent gives the following as a method whereby a perpetual motion may be obtained. He says he has seen a steam boiler advertised which saves $33\frac{1}{3}$ per cent. of fuel; a valve which saves 15 per cent.; a governor which saves 10 per cent.; a cut-off which saves 10 per cent.; a fire grate which saves 20 per cent.; metal packing and damper regulator which saves 12 per cent.; and a lubricator which will save 1 per cent., making in all a saving of 101 per cent. Combining all these improvements, an engine would, he thinks, run itself, and produce an additional one per cent. of fuel, which might be used for domestic purposes.

(Conclusion.)

* Reprinted from the SCIENTIFIC AMERICAN, 1870-71.

A motor chaise was proceeding across Ludgate Circus, London, when the driver, a young man, apparently noticing something going wrong with the car, turned it in the direction of the King Lud public house. There was then a loud explosion, which caused considerable consternation among the passers-by. The car immediately began to "run wild," but the driver preserved his presence of mind and managed to steer it against the curb. It was then discovered that the cylinder containing naphtha had burst. Fortunately, the naphtha which escaped did not ignite, and therefore an accident of a serious kind was averted.

## ENGINEERING NOTES.

**A new** batch of 30 knot torpedo boat destroyers is being turned over to the British Admiralty. Palmer's Chamois made 30·4 knots in the three hour trial, the highest speed on the mile course being 32·37 knots. Thornycroft's Mallard made 30·2 knots.

**There was** a collision on the Danish State Railroad near Copenhagen some time ago in which forty persons were killed and seventy wounded. The railroad at once admitted that it was to blame, and instead of fighting claims for damages, has appointed a committee to settle with the claimants what will be fair compensation, so as to avoid having the claims brought into the courts.

**The installation** of a railway line from the Caspian Sea to the Persian Gulf is at present under consideration. There are no great technical difficulties in the way of the enterprise, but it seems doubtful whether the Shah of Persia will consent to a step which will place his territory under the power of the great empire of Russia, nor can it be a pleasing prospect for England to know that Russian troops could, in case of the line being built, arrive at the Indian Ocean from Moscow within a week.—Uhland's Wochenschrift.

**The only** street railway in the entire province of Mozambique, Africa, is located in the town of Beira, writes United States Consul U. Stanley Hollis. This railway is about 2 miles in length, built on a 24 in. gage, and its entire rolling stock consists of one flat hand car capable of seating four people. Its motive power is from two to four stout Kaffirs. The Beira Tramway is owned by the Companhia de Mocambique, of that place. There has been some talk of a tramway at Lorenzo Marques, Delagoa Bay, but as yet nothing has been done.

**Tests recently** made on molybdenum steel by Prof. W. von Lipin, of St. Petersburg, show that molybdenum steel resembles tungsten steel in a general way, although it is less affected by annealing and tempering, says The Engineering and Mining Journal. Annealing makes it softer than tungsten steel; high heating, on the other hand, makes it harder than the latter. This steel can stand treatment in the fire as well as tempering better than tungsten steel, and shows no fissures where tungsten steel very often does. This may be the cause for the numerous attempts to substitute molybdenum steel for tungsten steel, and especially chromo-tungsten steel.

**Lord Kelvin**, in his recent address before the British Association at Toronto, gave some estimates on the available fuel supply of the world and made some suggestions which attract attention. He thinks that the utilization of water powers to the greatest extent will diminish only insignificantly the tax on the world's supply of fuel, and believes that the cultivation of vegetation which adds to the store of oxygen is of more importance than anything else man can do to prolong human life on the earth. He estimates that there exists 510,000,000 million tons of oxygen that will burn 340,000,000 million tons of fuel, but the diminution of the oxygen will destroy human life long before its supply gives out, so that the fuel that may be left after the race dies is of no avail. There are 200,000 tons of fuel for each person living to-day, which, he says, will limit the life of the race to a comparatively short span. But the growth of vegetation will be necessary to sustain life to this limit. Lord Kelvin calculates that the power now developed from the turbines at Niagara is only equivalent to the requirements of about ten ocean liners, and if the entire force of the mighty stream should be utilized, it would only be equal to the power of 100 of these ships.

**The view** from the Gorner Grat is considered to be the most magnificent in Europe. Monte Rosa looks close at hand, while the Matterhorn is so near that apparently one might throw a stone on it. The Gorner Grat railway, which, it is hoped, may be ready for traffic next year, will have its terminus at the summit, 10,000 ft. above the sea level, the greatest altitude yet reached on rails on that side of the Atlantic. It will start from Zermatt, where it will be connected with the branch of the Rhone Valley railway, which, in 22 miles between Visp and Zermatt, rises to the height of 3,160 ft. The new line consists of 9½ kilometers of rack and pinions, climbing the Riffel Alp to the Gorner Grat. Difficult corners are avoided by spiral tunnels having entrance and exit on the same rock face. About a mile from Zermatt it crosses a gorge by a remarkable bridge. The torrent will be utilized to furnish motive power, for the line will be on the trolley electric system. It has been only possible to carry on the construction for four and a half months in the year, and the traffic will be limited to a three months' season, as both railway and machine house will be mostly under snow for the remainder of the year. Under these circumstances the fares will be high, but people who want the luxury of a railway up a 10,000 ft. Alp must expect to pay for it.

**The first** light railway in England is now open. It connects Chichester with Selsey. The gage is 4 ft. 3½ in., which enables a junction to be formed between it and the London, Brighton and South Coast Railway. There are four stations on the line, but we hope they are only temporary and that the traffic will allow of the erection of more fitting examples. The canal is crossed by a drawbridge. At present the line terminates at a point about 200 yards distant from Selsey Church, but it will be advantageous to extend it before next summer for about half a mile, in order to bring visitors nearer the sea. One of the objects of the tramway is to facilitate communication with Selsey, which is likely to become a popular watering place. The success of the experiment depends in a great measure on the locomotives. The company were wise when they gave the commission for the two required to Messrs. Peckett & Sons, Atlas Locomotive Works, Bristol. The Chichester and the Selsey were specially constructed by this firm for mixed traffic, such as they are likely to have on this lime. The Chichester is a six-wheeled engine (four wheels coupled) and the Selsey four wheels coupled, with a two-wheel pony truck at each end, so that the weight is distributed. In consequence, a light rail is able to be used and economy is secured. The working of the line will be watched with much interest, and it is not unlikely that from other districts orders for similar locomotives will arrive.—The Architect.

## ELECTRICAL NOTES.

**Brooklyn has** 12,994 street gas lamps and 3,431 electric lights, says The Electrical Review. The total cost of the gas for the streets and public buildings for the year 1896 was less than $185,000, while the electric lights cost $357,698.

**Germany and** Spain are now connected by a submarine cable 1,250 miles long, the ends of which are at Emden and Vigo. It is the first link in a series of lines to be first extended to Brazil and to the United States by way of the Azores.

**Dr. Jameson**, of Transvaal fame, has taken charge of the construction of the transcontinental telegraph line across Africa from north to south. For the present it will not extend beyond Lake Tanganyika, says The Electrical Review.

**An electric** railway is to be run between Debreczin and Nagyvarad (Hungary), a distance of 38 miles. It will be the longest electric line of Europe. Debreczin and another town are at the same time to be supplied with electric light.—Electrotechnische Rundschau.

**Prof. Crookes** made the astonishing discovery that a diamond inclosed in a Crookes tube became covered with a black film. M. Moissan has investigated this film and has found it to be graphite. Further explanation is not forthcoming.—Electrotechnische Rundschau.

**The electric** street car line in Bernburg (Anhalt, Germany), was opened on May 1. It is the first electric tramway in the Duchy of Anhalt, and was built by the Allgemeine Electricitäts-Gesellschaft, of Berlin, Germany.—Electrotechnische Rundschau.

**An experiment** in the electric lighting of railway carriages is being carried out by the London and Northwestern Railway Company on its suburban line between Euston and Watford, says The Electrician. Each carriage is treated independently, having its own dynamo driven by gearing from one of the axles, and a set of accumulators to provide current when the train is not in motion. The Caledonian Railway Company is also experimenting with electrically-lit carriages on its Edinburgh-Glasgow line.

**According to** The London Electrical Review, an interesting process is now being conducted at Charlottenburg, Germany, by M. Mehner, by means of which ammonia and nitrides are produced. Oxygen compounds of such elements as boron, silicon, magnesium, titanium and vanadium, capable of combining with nitrogen at high temperature, are exposed to the heat of an electric furnace in the presence of free nitrogen and carbon. A high tension current must be employed and a jet of sand blown in while generator gas is introduced; on entering the hot zone of the electric furnace the sand is said to evaporate and then acts as desired. Nitrides thus manufactured may be treated with steam to obtain ammonia and an oxide from which a nitride may be reformed as before.

**A novel** electric elevator has been invented by H. Russell Smith, engineer of the Winslow Brothers Elevator Company, Chicago. It is stated to fully meet the exacting requirements of modern tall buildings and is styled an electromagnetic elevator, from the method of applying the power. Electrically driven elevators usually consist of steam or hydraulic elevator machinery operated by an electric motor of some variety. In this case, however, the solenoid, or coil and plunger, is used to apply the power to move a car. The inventor claims that in his form of apparatus there is far more to entitle it to the name electric than in any other style of elevator in use. An elevator built upon this principle is in successful operation in Winslow Brothers' factory.—Iron Age.

**The rates** of speed for street railway cars, as established by the ordinances and franchises in different cities, are as follows in and out of city limits, says The Electrical Engineer: Albany 12 miles per hour, Binghamton 12 miles, Brooklyn 6, 8 and 10 miles, Buffalo 12, 15, 18 and 30 miles, Elmira 7 and 15 miles, Rochester 6 and 12 miles, Allegheny (Pa.) 15 miles, Omaha 10 and 15 miles, Grand Rapids 7 and 15 miles, Washington 6, 12 and 15 miles, Boston 7, 10 and 12 miles, Denver 9 and 15 miles, Des Moines 8 and 12 miles, Columbus (O.) 8 and 14 miles, Dayton (O.) 10 miles, Evansville (Ind.) 12 miles, Kansas City 12 miles, Louisville 10 and 12 miles, New Haven (Conn.) 10 and 12 miles, Paterson (N. J.) 10 and 15 miles, Providence (R. I.) 9, 10 and 12 miles, Rochester 7 and 15 miles, St. Louis 10 and 12 miles.

**Of the** German telephone newspaper, described in these columns some time ago, The Electrical World speaks as follows, its authority being a German technical paper: "News is distributed continuously by telephone during the whole day, including some entertaining matter in the evenings, among which is always the overture at the opera house whenever there is a performance. It appears from the programme that stock quotations are given for 15 to 20 minutes about every hour or two; every few hours there is a review of the principal news items that have been transmitted before; the number of subscriptions has at present reached 6,000, including a length of wire amounting to 330 miles: it is stated that it is now possible with the apparatus in use to transmit simultaneously to 20,000 subscribers with sufficient loudness."

**It is** reported that a crucial test of compressed air as a possible rival of electricity has been made in a Colorado mine, says The Western Electrician. The tests extended over a month, and were made in every case under exactly similar conditions. Two small electric pumps and an air pump were placed side by side in an entry 10 ft. wide by 5 ft. high, with the exhaust of the air pump, into which a stream of water was discharged to prevent it from freezing, venting so near the electric pump that it was necessary to protect the latter from the water by an oilcloth. This was a good test for the waterproof properties of the motors. The result of the trial showed that the work of pumping by compressed air, which had formerly called for 312 horse power and eight boilers, could be done by electricity with but 56 horse power and one boiler, disregarding even the use of a compound engine and a condenser. In other words, the whole plant of pumps and machinery heretofore requiring eight boilers, taxed to their utmost, can be operated by a modern electric plant, with but one horizontal tubular boiler. The total efficiency of this electric pumping plant is estimated as close to 60 per cent.

## MISCELLANEOUS NOTES.

**On the** Glasgow underground railroad the experiment was recently tried of doing away with tickets and letting people ride as far as they wished for a penny. On the first day of the trial, however, many persons got into the cars and spent the day riding round and round. The directors did not have the patience to wait for the novelty to wear off, but restored the ticket system after a week.

**According to** recent French statistics, France lost 136,000 men by death through wounds, sickness or accidents in her war with Germany, while 139,421 men were disabled on the field of battle. Germany's losses were 79,155 dead and 18,543 wounded. The monetary loss is more evenly divided, that for France being 12,666,487,522 francs, and that for Germany being 8,000,000,000 francs.

**Bohemian sportsmen**, during the year 1895, shot and killed 50 men, women and children and wounded 2,104 persons, chiefly gamekeepers. They also killed, among other game, over 15,000 dogs, 8,762 cats, 2 horses, 15 cows, 132 calves, 276 goats, and 129 sheep. For this they had to pay collectively over $500,000 for doctors, fines and indemnities, and to spend 74,388 days in jail. The Austrian government collects the statistics.

**An apparatus**, called thermophone by its inventor, is devised for finding high temperatures, and is constructed on quite a novel plan. It consists of a clay receptacle, which is filled with some explosive substance. The article whose temperature is to be measured is brought near the thermophone, and, according to the time which elapses before the explosion takes place, the temperature may be found from tables drawn up by the inventor.—Uhland's Wochenschrift.

**In Germany** there is no special classified duty on bicycles, the small amount paid on wheels being only that due on steel. About 1 per cent. of the value of a bicycle is paid, while in other countries the customs are from 35 to 50 per cent. The German authorities are, however, considering the levy of a special duty on bicycles imported, as the present state of things greatly tends to increase the importation of foreign goods to the detriment of home manufacturers.—Uhland's Wochenschrift.

**The latest** returns of the British Board of Trade show that in 87 tin plate works 272 mills were at work, as compared with 278 at the end of June and 308 at the end of July, 1896. The number of works giving full employment decreased during July from 39 (with 212 mills) to 36 (with 191 mills), while works giving partial employment increased from 16 (with 66 out of 99 mills at work) to 18 (with 81 out of 116 mills at work). The number of works entirely idle at the end of July was 33 (with 172 mills), as compared with 32 works (with 168 mills) at the end of June. The continuance of trade disputes again accounts in some measure for the stoppage of mills. Returns received from owners of 55 tin plate works show that 10,772 persons were employed at the end of July, being 265 less than at the end of June and 1,975 less than at the end of July, 1896.

**The deterioration** of paper is a subject of primary importance, in view of the desirability of preserving permanent records, and it is well known that the material employed for many books and periodicals is, perhaps fortunately in some cases, not of such a nature that it may be expected to survive constant handling during many years. Care ought to be exercised, therefore, in selecting paper for printed matter that may require to be frequently referred to during a prolonged period. The Council of the Society of Arts is awake to these facts, and has appointed a committee to investigate the causes of the deterioration of paper. Pharmacy is represented on this committee by Mr. Michael Carteighe, the other members being Sir Owen Tudor Burne, Sir William Anderson, Mr. C. F. Cross, Sir John Evans, Dr. Richard Garnett, Dr. Hugo Müller, Dr. W. J. Russell, Mr. W. L. Thomas, Prof. J. M. Thomson, Mr. Henry R. Tedder, Dr. Quirin Wirtz, and Sir Henry Trueman Wood. This is a goodly company, and the result of the investigations to be pursued should be of world-wide interest.

**Municipal ownership** of gas plants in Great Britain and Ireland is said by The London Contract Journal to prevail in 203 municipalities, while there are 437 private companies. The ownership by countries is given as follows:

| | England and Wales. | Scotland. | Ireland. |
|---|---|---|---|
| Municipal | 160 | 36 | 7 |
| Private | 426 | 2 | 9 |

The same journal gives the paid up capital of the companies as about $225,000,000, and the sums borrowed by the municipalities as about $125,000,000. The total amount of coal used is given as 11,987,446 gross tons, with an output of 121,422,000,000 cubic feet of gas, of which 111,000,000,000 was sold during the year ending March 25, 1896. The mileage of mains on the date named was 23,857, supplying 2,659,771 consumers' premises and 526,888 public lamps. The gross yearly receipts of the companies is given as about $60,000,000, and of the public plants at $30,000,000, with respective expenditures of about $45,000,000 and $20,000,000.

**Terrific detonations** are heard down the Schuylkill Valley on nearly every week day, from morning until night. In a secluded ravine near the Reading Railroad the Monocacy Blasting Company is breaking up big guns with dynamite. It also smashes to pieces other huge iron castings, to be sold to scrap dealers. The noise of the explosions can be heard for miles. On July 6 the company received two historic cannon, which will be broken into pieces. They were brought from the Brooklyn Navy Yard on special cars and they weigh 96,470 and 95,625 pounds. The guns were used at the Vicksburg siege by Gen. Grant's forces, firing shots of 1,200 pounds. The government officials were loath to have the guns destroyed and offered them to a number of Grand Army posts, but the necessary arrangements could not be made to have them accepted. In a few days these historic field pieces will be smashed into bits and sold for scrap. The company has broken up many defective cannon bought at gun works. It also smashes nearly all the condemned guns for the war and navy departments. The dynamite is fired by electricity and a few men do the work.

## PRIMITIVE TRANSPORTATION.*

IN judging the degrees or grades of culture which have characterized the different peoples of the world, the first thing to search out is some kind of a yardstick—some kind of a modulus by which those peoples can be gaged and measured. Are Philadelphians at the bottom in the industrial scale, or are they at the top or in the middle? Where are you going to place Philadelphia in the culture scale?

Lewis H. Morgan, of New York, gives in his book on

FIG. 1.—JAPANESE MAN SHOULDERING A PACKAGE OF RICE.

Ancient Society a set of gages for social measurement, viz., three grades of savagery, three of barbarism and three of civilization—nine grades altogether, based on social organization and industries. But one of the best measures of civilization is the acquisition and domestication of power for mechanical purposes.

Some tribes of men have no power under their control excepting that of the human body. Whatever they do, they do with their hands; whenever they go, they go with their feet.

In the next grade, man avails himself of the animals—the llama or others—that have become sub-

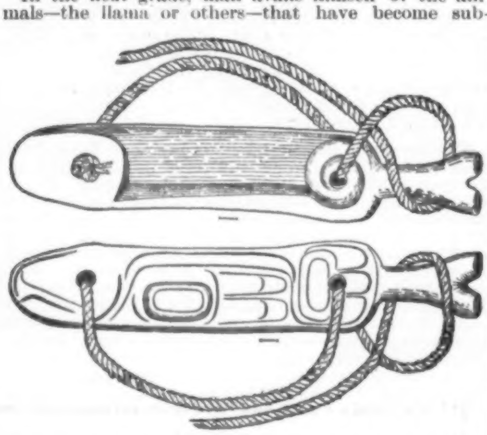


FIG. 2.—TREE-CLIMBING DEVICE OF TLINGIT INDIANS, SOUTHEASTERN ALASKA.

servient to his will, constituting beast power. Whatever be the agent—the dog, the hine, the llama, the camel, the elephant, the horse, the ass, the goat, the sheep—domesticated to come under human control, you have there an additional power added to the activities of a people. They feel the wind blowing upon their faces, see the trees bending before the gale, and the first thing you know some woman has made a mat out of grass and put it on the oar or paddle, forming mast and sail, and behold! the boat goes along through the water propelled by the wind. Or water itself may be used as a power, water floating or drifting articles

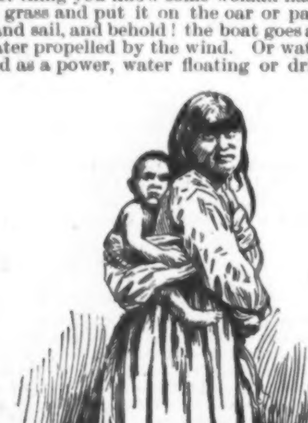


FIG. 3.—YOKAIA WOMAN CARRYING CHILD.

down stream or turning rude wheels. Man power, beast power, wind power, water power! Then add the power of fire—gross fire, fire that is more open and easy of access; after that the more refined uses of fire in steam, chemistry, electricity and light. As a result we have a series of domestications by which the peoples of the earth have conquered, one after another, these various forces of nature in order to their utilization as servants.

Looking backward, imagine a group of human beings walking upon the earth without clothing, without homes, but more particularly, without any skill. Of course they had shelter. If they wanted to go under something or into something for the purpose of keeping themselves from the rain, or the snow, or the

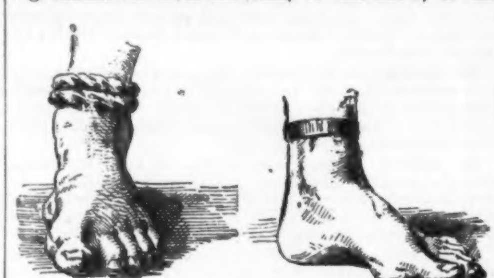


FIG. 4.—PERUVIAN ANKLE BANDS FOR TRAVELERS.

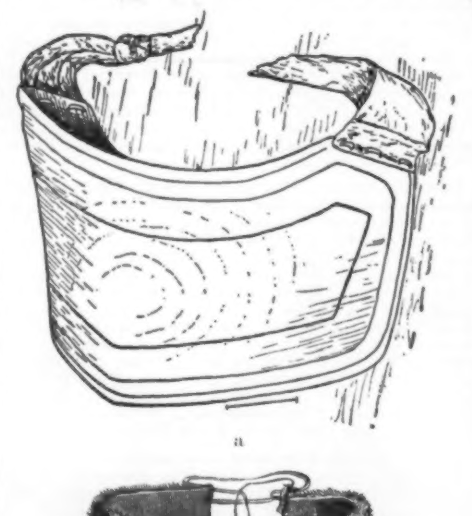
storm, or the wild beast, they had some refuge like the foxes or the moles; but they had no skill.

Mark well that epoch, that particular condition of humanity in which it was without skill; for it seems to me that the true destiny of our species is the artificial one in which we escape from the natural life and the natural proclivities and inexperiences into something that is artificial. When we multiply our wants for the sake of multiplying them, and multiply the means of gratification for the sake of multiplying our wants, we are in the stream of progress.

"Those poor wretches" (as Shakespeare calls them) "on the edge of time" had no skill, and from the skilless man of primitive time to the skillful man of Philadelphia is a long journey in many ways, in which the milestones are carrying devices, sails, windmills, engines and machines of infinite variety.

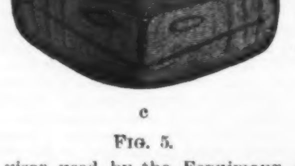
Now there are five sets of industries in which this skill in dominating power is manifested, going on from nothing to something, from absolute ignorance of things and from a want of experience in all respects to perfect knowledge, namely, exploitation, manufacture, transportation, commerce and exchange, and consumption or enjoyment.

First of all, Nature was endowed before the human period with materials that were destined to be useful to this coming race. The bounty of Mother Nature is so great that before there was a human being on the face of the earth there seemed to have been provided everything that man was going to need, if he would only look for it and find it, with this one exception: while the eagle had wings with which it could soar aloft, and the fish had fins by which it could swim, and the lion had fangs for tearing its food, and the mole



a

b



c

FIG. 5.

a, hunting visor used by the Esquimaux of Norton Bay, Alaska; b, goggle and eye shade made of the skin of a ringed seal's head; c, eye shade of carved wood, used by the Esquimaux of Anderson River, Mackenzie River district, Canada.

had the apparatus by which it could go underground, and each species, each family, each part of the animal creation was provided in itself, on itself, as a part of itself, with those tools and apparatuses that were going to be useful in the development of the life of those creatures, the finger nails of man will not compare with the toes of the bear; these little teeth I have in my mouth bear no comparison whatever to the teeth of the chimpanzee, or the tiger, or the lion; I have no wings with which to fly; I cannot go down into the sea very deeply, and cannot burrow in the earth like the mole. It seems to me if the animals had gathered around this weakling when first he made his appear-

FIG. 7.—THE PRIMITIVE UMBRELLA IN GUATEMALA.

ance on the earth, they would have said, "He is a poor naked wretch, indeed, and I don't believe he will stay here very long. How can he scratch for a living? how can he bite? how can he swim? He has no hair on his body; he will freeze; the hot sun will burn him up; he has no teeth by which he can grind coarse food; all of the apparatus of life seem to be so wanting in his nature; what is he going to do?" He lacked everything excepting that fertile provision of brain enlarged at the expense of bodily organs by which his thought could by and by be evoked. If he cannot bite like the lion, he can go to the volcano and there draw out the

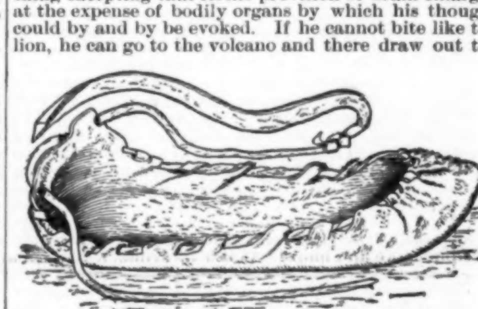


FIG. 8.—RAWHIDE SANDAL, WITH PUCKERED MARGIN, PACHACAMAC, PERU.

fire and learn how to create that fire himself so as to have in his hands a tooth that can bite sharper than that of the lion. He builds a little fire around his tent or his camping place and no lion dare go near him. The fang of the lion is very fatal, but the firebrand is more fatal. He cannot now fly into the air like the eagle, which can go only half a mile or so; but anon, you will see him soaring five, six, seven miles up into the air. The fish does not swim more than about a thousand feet down into the sea, but here comes along a creature who cannot at first even dive there; but by and by you can see him going down into the profoundest depths, and he will send machinery still further to investigate the bottom. Though he cannot

FIG. 9.—MAN'S ORNAMENTAL BOOT USED BY THE ESQUIMAUX OF POINT BARROW, ALASKA.

burrow into the ground like the mole, he will dig down one, two and three miles in the earth, bringing up the coal and iron, the gold and silver. There is nothing that any creature can do that he will not do by and by better.

Kind Nature has provided in the air, and the water and the earth the means of evoking this wonderful spirit of man; and the five sorts of industries of which I was about to speak would be, first of all, going to

* Lecture delivered at the Academy of Natural Sciences, Philadelphia, Pa., by Prof. Otis T. Mason, of the Smithsonian Institution, Washington, D. C. Revised by the author. The engravings are from Prof. Mason's monograph "Primitive Travel and Transportation," in the Report of the United States National Museum, 1894, and are loaned by the Smithsonian Institution, cuts 9 and 10 by the Bureau of Ethnology.

Nature for her gifts, to dig up something to eat, to move into the waters or under the waters and there find something to eat, to go into the forest or field and there find something ready to eat—only simply helping himself from the bounties of Nature. Furthermore, as he will some day want to make his clothing, mats, etc., of textiles, there was plenty of textile material at hand and raw stuff for all industries.

Now, it is a curious fact that, if you look at this first man, this first group of human beings, these beings worthy to be called men, you will find that they are doomed to be always dissatisfied, to be driven out. Inasmuch as they have to develop themselves from within, and not on account of, or by means of, any accessories they have on the outside of them. They have to be always and everywhere dissatisfied, first of all that nothing is in the shape in which it is to be wanted.

Fig. 10.—ESQUIMAU DOG HARNESSED FOR SLED.

It is said that the monkeys will take a stone and with it crack a cocoanut. The human creature is not constructed to crack a cocoanut in that way. He is first to be dissatisfied with the stone as a hammer, and to break off a piece and make some modification in the form and so become a tool maker. Whatever is, is wrong with him; that is his philosophy. It has the wrong form; he must change the form of it. As his species grows older and more skilled, he breaks the stone more and more. At last he grinds it to meal and to flour, and, last of all, he fashions therefrom his Dresden pottery, but is never satisfied with the forms of things. All the great manufactures of the world were evolutionized by this dissatisfied spirit in man.

Again, nothing is where it ought to be, even in the minds of little children. Most of the animals think that things are where they ought to be; they change the place little. But this creature that is going to dominate the earth is to be terribly dissatisfied with the places of things.

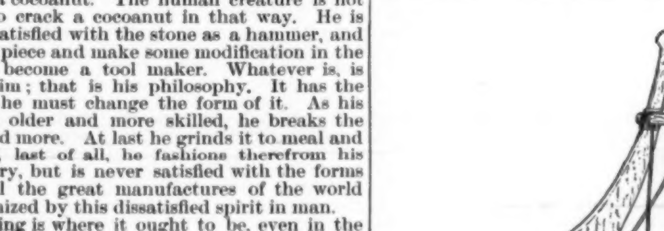


Fig. 11.—EASTERN ESQUIMAU SLED.

A third dissatisfaction is in the ownership of things. If there is one of these men living down on the sea that has been eating fish, and another on the hill eating nuts, the first thing you know is they are carrying their respective products one to the other for a change of diet. This swopping will lay the foundation of a whole series of industries. Forms of enjoyment are also ever changing to greater and greater complication of industry.

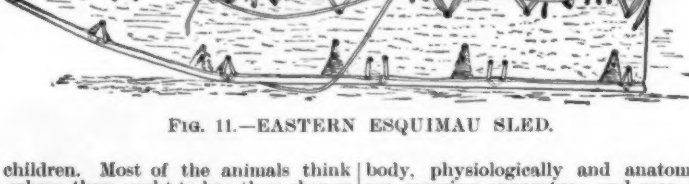


Fig. 12.—BUILT-UP SLED WITH BODY OF NETWORK—KAMCHATKA.

Therefore we have, first, getting the gifts of Nature; second, changing their forms—manufactures; third, changing their place, or transportation, and then the exchange or barter, followed by enjoyment, consumption, using things up in their daily exercise, constituting the fifth group.

Travel and transportation in their highest forms are illustrated in your electric cars, steamships, railway trains, chemical motors, heat motors, electromotors, photomotors. It was not always thus. The first traveler was a barefooted human being; the first common carrier was a woman, and she had very little apparatus to do with. The first passenger car was the body, a woman carrying a child! Not a naked body carrying a naked child; apes do that. That is not where artificial carrying begins; not as the sparrow picks up a straw from the ground and flies away with it in its beak to make a nest. With that primitive man or woman who first thought of a device to carry something with, originated the beginning of transportation, the beginning of artificial travel, of artistic travel, of human travel, at that time when some sort of an instrument was invented, or used, or picked up by means of which something else was to be carried.

Much has been written of the hand, the brain and other parts of the body; but lecturers will some day discuss the human foot as a carrying apparatus. The human back, the human shoulders, the human head, the human arms, the human hand and all parts of the body, physiologically and anatomically considered, are carrying apparatus; and man is a carrying animal.

How much has the carrying trade to do with human costume? Anthropologists say dress was originally some sort of mythological or artistic ornamentation of the body, wherein the idea of clothing was an afterthought. From our point of view, dress is the first thought; its artistic form, the secondary thought; its mythological significance, the third thought. The serviceable sandal came first, then the ceremonial shoe, then the wings on the feet of the gods.

People who stay at home don't need much costume. In the Esquimau hut you will find men and women without clothing; but they never walk on foot outside in that state. The first step they take abroad they must be clad warmly. In the sunny tropics people may exist without costume, without clothing if they live in the shade; but the moment they expose themselves to the heat they have also to invent some sort of costume. Just as a house everywhere shields the family — father, mother and children — against the storm, against the sun, against the wind, against the wild beasts, so against these four factors must any costume provide that man may don to go abroad, out from under the shadow and shield of his house, in order to travel or to carry.

The first invention differentiating the traveling man is some kind of out of door costume. What is a hat? A hat is a roof—an individual roof—a covering for the head. I must have such a roof as will not cover up my face. I must see, must hear, must smell, must put all my senses at work, so that this part of my body by which I look out upon the external world will be most exposed.

Fig. 13.—PAPAGO WOMAN WITH KIBO PROPERLY MOUNTED.

If it is to be a sunny exposure, I will make an umbrella hat; if in a cold country, a fur hat; if in a snowbound land, a visor hat. Perhaps I am to walk in a country where sometimes the temperature is 80° below zero; but being an ingenious creature, I am not going to be dismayed by any cold like that; so I will go to work and invent a covering equal to that climate. If, on the other hand, I am to live where the thermometer is 120°, if there is any danger of the sun blistering my head, I am perfectly equal to inventing an umbrella or palm leaf covering. We are not afraid of anything; we are endowed to be prepared for every emergency. So this whole matter of covering the head is one of balancing between the head and the outside world. Whatever may be the climate, whatever may be the environment, the little inventor will be equal to the occasion if necessary to modify or create environments. He says this hat is very hard to carry around when the sun goes down and I no longer need the protection. Can't I devise a hat that will take down? So the parasol or umbrella is invented—merely a hat that will shut up—whose main cost is in preparing it to be carried. In the whole series of head coverings you have this little inventor making himself happy, as Emerson says, "in all climates and conditions," because he can cover his head.

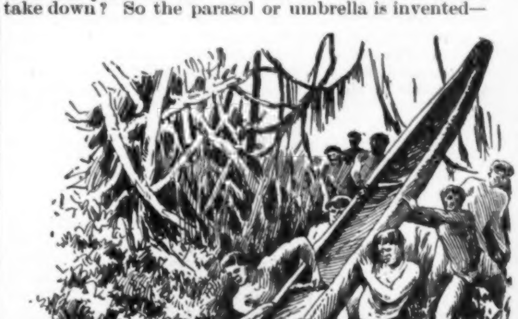


Fig. 14.—CO-OPERATIVE CARRYING—MEN ON THE SHINGU LAUNCHING CANOE.

The foot is the objective point of many traveling devices. What is the objection to going everywhere barefooted? Down in Baltimore there is a society that wander about in Druid Hill Park early in the morning, barefooted. They are perfectly welcome to their enjoyment. Our race, for a good many thousand years, have

made themselves comfortable with shoes. The human race walked over this whole earth. Before there was a beast of burden or anything tamed on which to ride, mankind had covered this whole earth. They must go on now to the end; the only problem is to be comfortable in the going. The first need was merely something to protect the foot from the ground, from wounding or the wearing out. This every one who has gone barefooted knows. You will stub your toes, or if you move into a cactus country you cannot go barefooted at all, or if into a tropical country there are many reasons why you must have something between your foot and the ground.

But, the moment you begin to travel or to carry, you are bound to look afteryour feet; and the sandal is the first effort to protect the foot of the traveling man from abrasions and the dangers that beset his way. No

FIG. 15.—APACHE SQUAW CARRYING CHILD.

wonder that in Grecian mythology they have Hermes with wings upon his feet. These wings are his sandals. The one invention that differentiated the traveling man from the stay-at-home was the sandal. Should any of you come to Washington, I can show you a very interesting collection of these. I have been trying to gather a sandal from every people on the face of the earth that wear sandals. Now, it is an interesting fact that in many of the inventions that have an imaginative motive behind them there is a great deal of differentiation of personal equation. If you, for example, should look at a collection of Moqui pottery, when you get the practical diameter of those vessels of a certain class, they are all between 8 and 9 inches in width; but when you read the symbols on these pots, out of 2,000 there will no two be decorated alike; when the potter came into the realm of fancy, of mythology, the individual mind just bloomed out into variation; likewise in the useful footgear there is a similarity that gives to the sandal a character of differentiation that is scientific. So when I examine the sandal of a Japanese and afterward look at another that is just like it, I say that is Japanese. No one ever saw a Chinaman wearing sandals. All the Japanese working sandals have

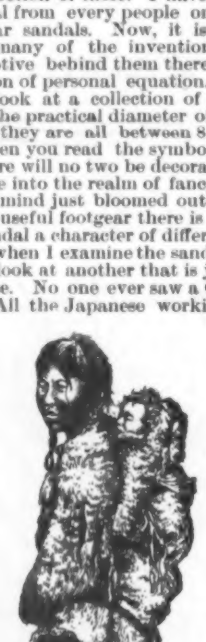


FIG. 16.—ESQUIMAU WOMAN OF POINT BARROW CARRYING CHILD.

the same characteristics; and these people in their daily life, in their daily arts, in their daily toil, have been brought, in some way or other, to use a certain type of shoe which characterizes their race and affiliations everywhere.

Suppose we have men on the Congo River. What do they do there? They carry, carry, carry, carry—on their heads, on their backs; year in and year out they have been going that way from the Congo down to the Gold Coast; streams of slaves going to-day just the same; and their feet are shod with shoes exactly adapted to the climate in which they are moving—just a little bunch of straw under their feet, to make a cool pad between them and the ground.

Under other conditions another kind of shoe will prevail. As you go north it is interesting to see how the sides of the sandal have been moving up over the feet—frosty nights making it necessary to get a little more covering. If you were to walk through Egypt into Palestine, into Turkestan, you would gradually convert your sandal into a shoe, and in the Siberian country into a closely made boot—the foot protected not only against abrasion from without but against the extremes of cold.

Whatever occasion may arise, you will find that as perfect music unto perfect words is this fitting or adapting of the thing used to its uses; this harmonizing of the man with his environment or surroundings goes on everywhere. Now here is a construction to be worn by a man who lives, I will say, in Alaska. It is of sealskin which has been sweated and the hair pulled out so as not to remove the thin, black cuticle. The sole has been sweated a little and the hair has been cut off carefully, leaving every bit of the cuticle. Why? Because it is a summer boot, to be worn when the snow is melting, and the foot is not only to be protected from the cold, but from the wet. That is an Esquimau waterproof boot—the upper leather tanned in the usual way. For walking over melted snow there is nothing better than that. The edge of the sole has been carried up and split; the upper leather brought down, and the seams sewed together in such a way that no water can enter.

Going around in winter the Esquimaux would have on

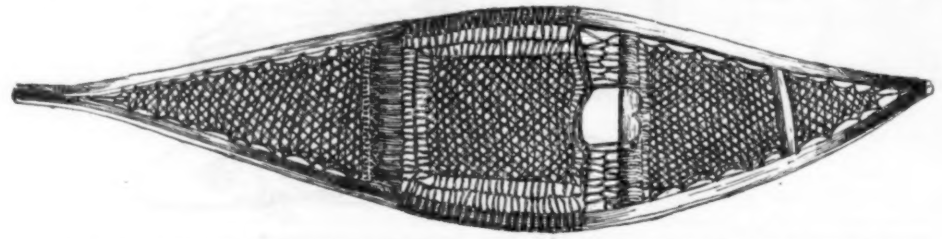


FIG. 17.—NETTED SNOWSHOE, POINTED AT BOTH ENDS—PROBABLY SIOUX.

a very different kind of a boot; but it would be exactly adapted to the conditions under which it was to be used. The same genius shown in our day in constructing electric engines is shown by these people in overcoming the difficulties which confront them. Snowshoes also form a very interesting study in this line of invention. These must have come from far North, where the snow is hard. Since the netting is coarse, the snow must have been so packed that the hunter walked on quite solid ice. In fact, the coarsest lacing either comes from the Chukchi country in northeastern Asia, or from Alaska somewhere near Behring Strait; but as you go southward you have the same story told of harmony between the ingenious mind of the individual, the inherited or tribal idiosyncrasy and the ever varying environment. The Canadian snowshoe is identified by the fineness of the mesh and the net filament. As you go further south the snow is more liable to push up through the meshes like plastering through laths, and ball up on the snowshoe. The meshes must become smaller and smaller in order to fit them to the quality of the snow. When you reach the northern boundary of the United States, the function of the snowshoe is ended. But impelled by the irresistible spirit of progress men had to puzzle their inventive brains to improve on mere foot travel. They went to live, we will say, at some time or other, in a region surrounded by wolves—rather near to them at times—only that men had invented fire and could kindle a little circle of fire around them, outside of which the wolves howl and yelp. In the daytime these people went out of their villages and hunted the deer and the bear for food. The women cut the hides off on the outskirts of that little village, and stripped the meat from the bones. The wolves came nearer in order that they might gnaw these bones; and so a kind of treaty, or flag of truce, is sent in by the wolves. They say, "We will bark at night when there is any enemy around, and you will let us pick these bones in peace." If a mountain lion approached, these village wild beasts set up their yelping and barking, the men going out armed in order to defend themselves. If a herd of deer approached, the wolves gave notice also. Later the wolves became the scavengers of the village and the children began to tame them and lay burdens on their backs; and the men said, "You may help me carry this load;" and so the wolf becomes the domesticated dog—first a wild savage, comparative enemy, then a mutually respecting society; then a mutual admiration society; then a mutual co-operation society; and by and by comes along the period of individual ownership, and these wild, savage, bloodthirsty wolves become our domestic dogs—works of art; and we breed them just for the amusement of it.

So with the horse. He begins to find that man is more near to him than an enemy. He is hunted for food, but by and by it is found out his back is worth more than his meat; and so he is domesticated. So with the sheep and the reindeer and the camel. They have come and said, "Here we are. We will enlist in your regiment and in your service."

Animal power is now harnessed up for the use of man. Notice this, however, that in addition to the enslavement of animals, men continued to be burden bearers. The more that animals were domesticated, the more work men had to do; because their wants increased. Men toiled harder when the dog and reindeer and horse came into their service than before. The more power we get into our hands, the harder we work. I do not believe any savages that ever lived worked so hard as does a stoker in one of your comfortable steamships or a roustabout on your wharves. The more we harness up these powers—the more they are brought under our sway—the harder we have to work to enjoy them; and so it has gone on.

Now as to the use of appliances—of harness—in this work of transportation. The African in Southern Africa has a splendid head of hair, and they are not going to muss that elegant covering in carrying. So they do their transportation on their backs in great frames. The Esquimau does not carry heavy loads at all. They have a most excellent substitute for their backs in sledges or sleds. The snow is Nature's track. Long before there were any steel rails, Nature had laid all along the hyperborean region the most delightful track in the world; and these sledges placed upon these tracks go along so easily that a man can drag four times as much as he can carry on his back. The Esquimau is capable of lifting heavy loads, but he does not carry them long distances.

Coming a little further south, we find the Chilcat man—his coast is very short, his mountain very long; and across the mountains are the great Athapascan people and the mountain people who have the things that he wants; so he has to harness himself up in a way to make carrying easy. His plan is to take a strap or piece of leather and make a bandage, resting it across the forehead and putting the load upon his back. All the muscles of the head and neck are involved—part of the load resting on the shoulders, and on the back between the shoulders and on the hips; so that every carrying muscle, every part of that man's body that is capable of carrying, is involved in the operation.

Carrying with the head band and basket on the back is an American habit. It existed among the northern tribes from the earliest information we have, all down the California coast. To-day the women who do the carrying (they are the beasts of burden always and everywhere) have baskets which fit upon their backs and shoulders, and head bands across the foreheads. Mexico is the greatest land in America, and perhaps in the world, for carrying with the head band. You cannot get a photograph of anything in Mexico but some old fellow has a great big jar of water on his back; or there is a peon coming to town with a basket of meat on the back of his head, or swung from his forehead, perhaps, 200 pounds of meat—bringing them in over the hills, or over the rough passes of the mountains, competing with the railroads and underbidding them, because they have such short journeys.

Still further, in South America, you see woven into their tapestries and everywhere across the mountain sides the people with bands across the foreheads and a load upon the back. The Pueblo Indians may have possessed the head ring for toting, but the great carrying business of this continent was done on the back, with the band passing over the forehead.

In Africa, away from the Bantu country, the real negroes—the negroes of the Soudan—carry loads on their heads. Dr. Brinton's "Nations and Peoples" discusses this question among the Hamitic people of Northern Africa, but all negroes practice it as well. Carrying on the head has also prevailed all through southeastern Asia, in Phenicia, over across into the Mesopotamian Valley; in the Philippines. Down among the peoples of Polynesia toting is a very common practice, with or without harness.

When the load was transferred from the back or head of the man to the beast, of course the harness must be modified; but the main structure of the harness or strap of the man was simply taken from his body and put upon the body of the beast.

NAVIGATION OR WATER TRANSPORTATION.

Another very important link in this chain is that of navigation or traveling on the water. It is easy enough

FIG. 18.—WOMAN OF BRITTANY CARRYING CHILD.

for a man to get on a log or a bladder and float across a stream. These might not be called navigation devices at all. Navigation, or traveling and transportation on the water, as also land locomotion, would begin with some kind of an artificial device which would differentiate the boat or the ship from the mere flotation. Mere flotation, perhaps, is not navigation; yet the earliest forms of travel by water were simple flotation; but the apparatus is a manufactured one.

Going up the Mississippi or Missouri River thirty years ago you would have seen an Indian woman stretching a buffalo hide over a frame to make a very ugly looking tub. Into this tub she got with her luggage and crossed the Missouri River. In order that this craft might be steadied in its course and brought across the river, she had to invent some sort of steering gear.

The differentiation of navigation from mere floating took its rise in the invention of the keel. The simplest forms of primitive boats exhibit some effort to guide the vessel on its course, in the direction in which it does not want to go. If it tends to go this way, the human quality is to make it go that way; if the wind blows it east, the human quality compels it to go south or west. This boat is to be modified to go away from the course in which nature would take it into some other course according to the human will. This is the perfection, say, of an Esquimau woman's boat, in which the skin is drawn over a frame and the woman stands along the side and paddles it in still water.

But the man's boat, in which he is not to be afraid of any danger, in which he rights himself if capsized; puts himself down into it through a little hatch; covers himself with a waterproof jacket lashed at the bottom or lower hem around the coaming; and so tightens his craft that no water can get in there, in which he faces the sea, goes out to hunt the walrus and the seal, furnishing really a first attempt to guide a craft and make a seaworthy boat. The most successful people in the world for navigation of this primitive sort are the Polynesians, who discovered every island in the Pacific Ocean 400 years before Columbus—without compass or guide of any mechanical sort, and in open boats. But they had invented three requisites to voyaging: first, to manufacture dry food—to dig a native root and grind and condense it in such a way that they could carry subsistence for a long journey; secondly they had invented a shifting sail. These poor fellows had indeed no tackle; but whenever they wished to bring the boat on the wind or off the wind they had to climb up to the masthead, untie the sail, bring it down, turn it around and put it on the other side of the mast and then sail other end first, making one end of the boat now the stern and then the bow, so that they could tack back and forth in a wind. The third epoch-making device was the outrigger. The Polynesian boat is sharp, like a very thin canoe. Across the top are timbers to which an outrigger is lashed, so that when the wind is leaning her over in one direction the sailors can climb out upon this outrigger and right her. With that craft and its outrigger and poorly shifting sails, in that little device, with their dried root and their perfectly fearless manner in the sea, the Samoans and Tongans managed to cover every archipelago in the Pacific Ocean. They went all the way from the Society Islands to the Sandwich Islands; from the Society Islands to the Easter Islands and to New Zealand; and from the Society Islands to Madagascar. From this point to the Easter Islands is over 3,000 miles.

TRANSPORTATION OF PASSENGERS—THE PASSENGER TRADE.

The first attempt to transport a human being was made by a woman in carrying her baby around in some sort of device.

In the tropics the baby does not ride in the cradle, but crawls around on the mother's back, aided by a meager girdle. How it sticks there I do not know; but whenever you examine an African picture or South American picture of native life, you will see babies crawling around on the bodies of their mothers, very little clothing on the bodies of either, and yet the youngling manages to stick there. As you go northward the little thing begins to find a refuge somewhere.

As you go further north and the climate is colder—the temperature difference between the body of the child and the outside increases—the little fellow is gotten into some sort of a frame. In northern Mexico it is a hurdle, with a fringe or covering of deer skin; and in the cold of early morning or late in the evening this is simply thrown over the body of the child. And when the day grows warmer this curtain is thrown down. A little further north and you will find the frame to be a trough, made of cedar; and the little one is laid in it and covered with the cedar bark. And still further north, the bed is made of fur or rabbit skins, and a little deeper it lies in this shroud or covering and it is still further protected from the climate. There is a regular harmony in this gradation. When you get to Mount St. Elias, no more cradles—too cold. The mother has a great big bonnet on her head, as large as a half bushel. The baby rests in this hood, just like the mouse in its nest; so that the carrying of a child from the tropical parts northward to the Arctic region is a tune—a kind of harmonic arrangement between the tender sympathy and care of that mother and her little helpless baby, whose life is so dear to her, and the meteorological conditions of nature.

When you cross Behring Sea into Asia you come to the same cradle you had in British Columbia—it is a wooden dugout. It can be carried on the mother's back and the child covered in and perfectly protected. But when the natives take to riding on the reindeer, or on the plains of our country begin to ride horses, and there is danger in the carrying of the child that, if it falls off it will be injured, you will find another arrangement. The Sioux Indian cradle is after this fashion, and, among all those Indian tribes where the child is exposed to injuries from falling or from wounds, there is seen a mother's provision of something to protect against the danger. The invention is always equal to the emergency. All through northern Siberia that kind of cradle is used.

The carrying of passengers on human backs becomes, in the next cultured grade above, riding on beasts. At one place they make the reindeer the "saddle horse;" in another place, the elephant; in another place, the elk; in another place, the cow; but the first beast riding is on the animal's back, with a saddle; in the next, the creature drags man over the snow in a sled or hauls him in a wheel vehicle. In Alaska, Arctic Canada and Greenland the sled is an excellent invention for the study of ethnic peculiarities co-operating with diversified surroundings. Examples from northeast Asia were brought by the Russians, who came into Alaska that way.

The north of Greenland sled is, in comparison, a poverty stricken patchwork of wreckage, held together with rawhide thongs.

The animal that draws the sled is, in every case, throughout the western world, the dog.

The origin of the wheel is a mystery, but it never could have originated in any other than a flat country. There are no roads in nature. The first roads were paths of animals, called trails; then men walked in those trails and they became paths, and after awhile became human roads, along which beasts of burden came. By and by, perhaps through some sort of a drill of these animals, in which they required more road space, the road became wider; but certainly the wheel did not originate in a hilly country. It originated in northern or western Asia, where there is a vast plain, and where all nature is one great road. To trace the four-wheel carriage of moderns through all its phases, from the original one wheel, is a long story —but it has developed in historic times.

Along this early track we travel in order that we may find the first fruits of that thinking, devising, inventing, which lie at the foundation of the most wonderful spectacle that we see to-day. We never sit down to a meal that we are not partaking of the labors of the whole earth. Our breakfasts, our dinners, our suppers, our dress that we wear, our furniture that we use—the blessings that we enjoy every day—are gathered in from the four corners of the earth, as though we could shut our eyes and hear the tramp of human feet and domesticated beasts for thousands of years over the earth, preparing the way for these great modern industries that we call transportation.

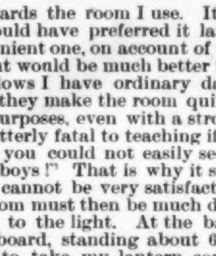
## PHOTOGRAPHY AND GEOGRAPHY.

By A. E. MURRAY.

As the lantern and photography are hobbies of mine, I have much pleasure in communicating a few notes as to teaching geography by means of photography and the lime light.

First, as regards the room I use. It is about 15 feet square. I should have preferred it larger, but it was the only convenient one, on account of the windows. It faces south, but would be much better if it faced north. Over the windows I have ordinary dark green roller blinds; I find they make the room quite dark enough for teaching purposes, even with a strong sun shining. It would be utterly fatal to teaching if the room were so dark that you could not easily see your class, for "boys will be boys!" That is why it seems to me that an oil lantern cannot be very satisfactory for the purpose, as the room must then be much darker.

Secondly, as to the light. At the back of the room I have a cupboard, standing about 6 feet high, just wide enough to take my lantern comfortably, with space at the back for gas pipes, etc. The whole of one side and the upper part of the front are doors. The pipe for the ordinary house gas comes down at the back of the cupboard to a tap inside it. The lantern itself stands on a shelf, sufficiently high to clear the boys' heads. Below at the back, but inside the cupboard, stands a box containing a 40 foot cylinder of oxygen gas. The rest of the space beneath the lantern is fitted with shelves to hold the boxes of slides, etc.




W, window; D, door; C, lantern cupboard; F, forms, S, sheet; T, teacher.

A word as to the lantern. I will not go into all its merits, for it might lead me to blow my trumpet too loudly. I will simply say that it was made for me after my own pattern. The only special point I must mention is the jet, for, after about 20 or 25 years' work with the lantern and after making several jets myself, I am convinced that for ordinary purposes, say for a disk 12 feet square, a great deal more oxygen is used than is necessary. My jet has so small an orifice that I only burn 1 foot of oxygen per hour. Also the arrangement of the nozzle of the blow-through jet is seldom, in my opinion, satisfactory. The lantern is kept always connected up with the gases, and, therefore, when the time for the class arrives, all that is necessary to be done is to put on a lime and turn the taps, and then everything is ready. In passing I may say that the cupboard is also most useful for enlarging, for, with the side door shut and the front door open for the nozzle of the lantern, it is almost dark enough; but with a piece of black twill lining fastened in front, with a round hole for the lens of the lantern, absolute darkness is obtained. A hole may be cut at the top of the cupboard to let out the heat. One more wrinkle before leaving the lantern. When I was inexperienced, if a lime broke I threw it away, but now one often lasts me for a week or more. A lime nearly always breaks in the center. Don't try to join the old breaks together if you want to use it again, but put the top and bottom ends together thus. You will find the crack will not affect the light at all, and the lime will have no tendency to break again. I far prefer the hard limes, even for

the blow-through jet, especially for semidaylight lantern work. The light is much whiter, and the hard lime withstands the dampness of the atmosphere longer. Often I leave a lime a day without putting it away, but my usual plan is to put it back into the brass tube the same night.

In front of the lantern I usually have three forms arranged as shown on the sketch. On the opposite side of the room there is a frame about eight feet square, on which a piece of white calico without a seam is stretched. Of course, if the lantern is tilted much, this ought to be slanted forward a little from the top. When teaching I usually stand about the spot, T, with a thin pointer in my hand; I need hardly say I point with the shadow, not the substance.

Now as regards the maps I use. Some I have bought, but I was so disgusted with many of those I purchased, that a year ago I determined to take up photography, chiefly for the purpose of map making and copying diagrams. Before coming to this determination I tried several of the best makers who profess to supply maps for the lantern. I will call the first firm Messrs. A. They photographed their slides from colored originals, hence some parts were very dark indeed; the maps were crowded with names. They were photographed at least twenty years ago, and the price colored I think was 3/6 each. Next came Messrs. B. Many of their maps were very good, but very expensive; I asked them to photograph one specially for me, and I supplied them with the original. When it came home it was so foggy I was ashamed to use it. A colored map I had from them is an utter disgrace to anybody, and when I complained they said it was quite true, they were very disappointed with the man who colored it, but now they had somebody far better! Another map, of Scotland (which took in a part of England), showed a large portion of Northumberland overflowed by the German Ocean. When I came to use the map for the first time I felt as much "at sea" as Northumberland must have felt. After these experiences I thought I would try Messrs. C. I wrote to them for several maps, including one of Palestine. It duly arrived, and on it all the towns, villages, etc., were duly recorded en masse, thus making it very unsuitable for a slide. I requested them to color it for me, but, alas! several of the divisions were completely miscolored! I have tried a local man, but, of course, I had to supply him with suitable maps, and I must say his photographs were as good as I could wish.

Now for my own work. Being only an infant of a year old, as may be imagined, I am not perfect yet in slide making, but I can turn out slides which are clear in the clear parts and of a good depth in the others. Personally, I like amidol best for maps; it develops very rapidly and does not seem to give the other part time to fog. Out and out the best maps I know for photography are the series published in "Outlines of Geography," by Somerville & Thompson (Percival & Company). The paper is very white and the outlines thick and black, only the important places and features are inserted. The maps themselves, here and there, are not over-correct, e. g., in the map of Europe the Apennines have disappeared from Italy, and in the map of England, Bardsey Island from off Wales, but these are trifles. Unfortunately there is no map of England divided into counties, but instead what I think almost useless, one crowded with railways. I should like to come across a series of physical maps equally suitable. To teach geography properly, there ought to be at least three maps of each country—physical, political and blank. Besides maps of countries, I also use maps showing the winds, ocean currents, etc., and I hope by and by to add geological maps. I have found it most useful to photograph the diagrams as to map making, the bed of the Atlantic, etc., given in Grove's small geography, which is the textbook for the entrance examination for the Britannia—in fact I photograph (when time permits) any picture I think suitable for the purpose, e. g., a bird's eye view of the Crimea, to illustrate a peninsula and an isthmus. But I do not confine myself to maps and diagrams. Since teaching geography by the lantern, I have been accumulating slides of different places of interest, for example, Niagara Falls, Giant's Causeway, etc., and at the end of a lesson, if the class has been attentive, I reward it by throwing on the screen two or three slides bearing, if possible, on the subject we have been taking. I consider that the results are most satisfactory, as the teacher can teach far better and the boys themselves like the plan, and I am certain they take more interest than in the ordinary way. It is also a very great advantage being able to change from one map to another so easily. The cost is decidedly not great, if you take into consideration the amount you have to pay for large school maps, and the trouble is very trifling if you have everything properly arranged and at your fingers' ends.

There is another way in which I have pressed photography into the service of geography. At the end of a term I usually want boys to fill in a map of which I give them the outline; I could not keep at hand hundreds of outlines of the different countries, so I prepare the outlines as follows: Using the lantern cupboard and the original negative, I make an enlargement on bromide paper just large enough to be copied in the cyclostyle, quarto size; I lay this enlargement on the usual thin paper of the cyclostyle and go over any lines I want to copy with a lead pencil. This makes a distinct whitish line on the cyclostyle paper. I go over this outline with the cyclostyle pen and then print off as many copies as I require. This term I used Africa, South America and Australia, prepared in this way. The enlargement will last practically for ever. No one who has not tried the plan can imagine how easy it is.

I see I have omitted all mention of coloring. Unfortunately, I cannot get time to color many of the slides, but undoubtedly it is better to do so. I have colored several in outline and find it quite sufficient. I do not think any amateur could color the whole surface of a map satisfactorily without great practice. Lastly, I may mention, although not connected with photography, that I sometimes make simple diagrams on a glass cut the size of a lantern slide, and covered with a dark orange preparation. Those I used came from Newcastle. The diagram is drawn in pencil and then gone over with the point of a needle; this produces very effective slides, the lines being bright on a dark background.—Practical Photographer.

## JAPAN AND THE UNITED STATES TARIFF.

IT is quite evident that Japan means to make her influence felt in the world whenever and wherever she legitimately can. Some time ago she let the United States of America know that she had interests in Hawaii which are not to be lightly put aside, and, indeed, wherever Japan's interests are affected, there she has agents who intelligently and clearly do all in their power to safeguard them.

The United States tariff has lately been receiving the

great attention of the Japanese Chamber of Commerce, and memorials and representations have been made to the United States government and to the American Chamber of Commerce, pointing out the disastrous effects which the proposed tariff would have on the trade between the two countries. These representations do not seem to have had much effect, as the tariff bill has passed with a few modifications; still, as indicating the opinions of intelligent and influential Japanese on the question, it will be interesting to note the action which has been taken in the matter by the Yokohama and Tokyo Japanese Chamber of Commerce. The chairman of the Tokyo Chamber of Commerce telegraphed to the chairman of the United States Senate Committee on Foreign Relations, to the effect that if the tariff bill were carried out, it would ruin the trade between the United States and Japan, and, therefore, the Tokyo Chamber of Commerce requested the committee to give the matter its most serious consideration. The Yokohama Chamber of Commerce, in its memorial, pointed out that the United States of America occupied not only a most prominent position among the countries with which Japan was commercially connected, but also that it had close relations with Japan in other respects. The recent expansion of the Japanese maritime service had so considerably increased the facilities of communication between the two countries that the opportunity presented itself for the furtherance of mutual commerce. Under these circumstances it was absolutely indispensable that both nations should take such steps as were calculated to enlarge their commercial relations, to consolidate their friendly feelings toward each other and to promote mutual interests. If the proposed tariff were put into effect, it would have a disastrous effect on the trade, and be sure to impair the commercial peace existing between the two countries. The comparatively high taxes contemplated by the new tariff are to be imposed upon silk manufactures, tea, carpets, fancy matting, and earthen and porcelain wares, all of which constitute staple articles of production in Japan. The memorial admitted that the trade between Japan and the United States in past years had been rather one-sided. The United States had proved excellent customers for Japanese raw silk, silk manufactures, tea, etc., while Japan had only bought kerosene oil, flour and a few other commodities. But recently there had been wider developments, and locomotives and machines, cotton, velvets, hardware and many other articles formerly imported from various countries of Europe had recently been purchased from America. Thus commerce with America had been advancing in proper sequence of progress, with every prospect of a brighter future, and it never entered the imagination of Japanese business men that such a tariff would be presented to a legislature which, to a certain extent, had always exhibited toward Japan a warm sentiment of sympathy. The memorial from the Tokyo Chamber of Commerce was in very similar terms. Indeed, it went so far as to say that the proposed tariff could not but give rise to a suspicion that the object of the projected tariff revision was especially to prohibit the importation of Japanese manufactured goods. Bearing in mind that Japan had always felt a lively gratitude for the good will shown by America, the memorialists were at a loss to perceive what had induced her to take this sudden action. While admitting that the balance of trade had always been against America, the memorialists said that so great has been the Japanese desire to show their good will to that country, that they had sincerely endeavored to maintain a balance of trade between the two countries by giving large orders for rails and warships. This is a confession which ought to be noted by British steel manufacturers and shipbuilders. The memorialists stated that when they found, notwithstanding these expressions of good will on the part of Japan, that America actually proposed to prohibit the importation of Japanese manufactured goods, the whole nation could not but be astonished at such unexpected action, which would not only seriously injure their national feelings, but also be prejudicial to the trade between the two countries.—London Engineering.

## THE GLOW WORM AND THE X RAYS.

SEVERAL Coleoptera of the tribe Lampyridæ possess the property of emitting light, but the name of glow worm is reserved especially for one of the most widely distributed species, the Lampyris noctiluca (Fig. 1). This is an insect belonging to the order Coleoptera, tribe Malacoderma, and family Lampyrids. The light of the male is scarcely visible. It is the female only that, properly speaking, is the glow worm. The larvæ also are called by this name, but they are always less luminous than the females. The photogenic apparatus (Fig. 2) occupies the underside of the three last rings of the abdomen in the female, and of the two last in the male, in which it is but slightly developed. The larvæ, which are alike in both sexes, feed especially upon terrestial mollusks. They pass the winter in a torpid state. At the moment of pupation, their skin splits upon the sides of the thorax, and not upon the back, as happens with other Coleoptera.

The chrysalis of the male is immovable, as in all the insects of this order, but by a singular exception that of the female is agile and phosphorescent like the larva and the adult (or perfect) female. The eggs likewise are phosphorescent. The adults begin to make their appearance at the end of May. The phosphorescence lasts for two or three days after death (to a slight degree), and Macaire (Annales de Physique et de Chimie) has shown that it may be rendered sensible by heating the insect.

This magic gift has long rendered this insect as celebrated among children as in the world of naturalists.

Without going back to Pliny or to the encyclopedists of the middle ages, several scientists of our century have studied its curious luminosity; and among others, Macartney (1810) and Matteucci (1843), who have thrown much light upon certain points. In 1880, the question was taken up by M. Jousset. According to his researches, the granular protoplasmic cells produce a substance that becomes luminous in contact with the air introduced by the tracheæ, and the phosphorescence of the lampyris is a general property of the protoplasm, proceeding from a disengagement of phosphureted hydrogen.

These conclusions do not seem to accord with the researches recently made by Prof. Muraoka, of the University of Kioto. Let us give these latter a moment of our attention. M. Becquerel, having found that certain fluorescent substances, such as the salts of uranium, emit rays analogous to those of Roentgen, the Japanese physicist conceived the idea of examining, from this view point, the light of the lampyris; and following are the principal results obtained in the course of his investigations, an account of which is given in the Annalen der Physik und Chemie.

In a preliminary experiment, this scientist placed thin plates of copper, aluminum and brass alongside of each other upon a photographic plate. In order to prevent a contact of the plate with the metals, he interposed a sheet of cardboard provided with a circular


FIG. 1.—GLOW WORM.

aperture in the center. The whole, placed upon the bottom of a flat box, was covered with several thicknesses of black paper. He placed upon this about three hundred glow worms, which, along about the middle of June, are met with in abundance in the environs of Kioto, and hunting for which is one of the favorite pastimes of the gentle sex in the empire of the Mikado (Fig. 3). A net prevented them from flying away during the two days in which they were held as prisoners, and the apparatus was arranged in a dark room, to prevent the effect of extraneous light.

The question was to ascertain whether the rays emitted by the worms and filtered by the paper were capable of passing through the metals, and then of acting upon a photographic plate. The circular apertures formed in the sheets of cardboard permitted of the estimation, by comparison, of the intensity of the action. It was remarked that the parts of the plate in contact with the sheets were blackened, while the places corresponding to the apertures were unaltered.

But was the photographic impression due solely to the simple contact of the cardboard? In order to solve this question, Prof. Muraoka repeated the experiment in suppressing the metals and in leaving only the sheets of cardboard provided with a circular aperture. Upon development, the part corresponding to this aperture was black, and the parts in contact did not appear to be so dark. The juxtaposition of the cardboard and the photographic plate was therefore not the sole cause of the phenomena observed.

On another hand, upon reversing the order of the experiment, that is to say, upon placing the plates of metal directly upon the photographic plate, and the sheets of cardboard on top, the places opposite the apertures underwent no alteration, while the rest was uniformly colored. Nothing occurred, however, when there was arranged upon a plate of copper provided with an aperture a sheet of non-perforated cardboard. Besides, aluminum was more easily traversed than copper, and the latter still more easily than tin. As for the thickness, that did not seem to play much of a part. The same was the case with the color of glass, which had no influence whatever upon the transmission of light, and contrary to what occurs with the Roentgen rays, the substances that cause fluorescence were permeable to the light of the glow worm. Yet there was, as with the X rays, a certain relation between the permeability and density. Finally, the phenomena manifested themselves only when the sheet of perforated cardboard was placed either in direct contact with the photographic plate or beneath a plate of metal or cardboard that filtered for a second time the rays that had already passed through black paper. Upon increasing the number of the sheets of perforated cardboard (these being superposed one above the other), the intensity of the photographic impression was correspondingly increased.

From all these experiments, as well as from others that are not so important (for which we refer the reader to the original memoir), we have the right to conclude that the light of the glow worm depends especially upon the matter interposed. If there is nothing between the insect and the plate, the rays emitted behave like ordinary light. They are capable of being reflected, refracted and polarized.

On the contrary, the rays transmitted by the cardboard or the copper plates possess properties that are analogous to those of the famous X rays. They appear to acquire these during their passage through the

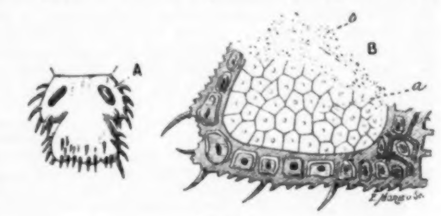



FIG. 2.

A, photogenic organs of the larva of Lampyris noctiluca; B, magnified section of one of those organs; a, granular cells; b, crystallized granulations.

"filtering" substance, and vary with the latter. They are capable also of being reflected, but are neither polarized nor refracted. Finally, what is an interesting peculiarity to point out, these "filtered" rays possess some of the properties of the ultra-violet rays as well as of the Roentgen rays. Would it not be more logical, then, to admit that the lampyris emits two kinds of rays—the ordinary luminous rays and the Roentgen ones? This luminosity, which has defied the sagacity of investigators for ages, is very curious. Prof. Muraoka has desired to lift one corner of the veil. Has he succeeded in getting any nearer to a solution of the problem? That is the question. However this may be, it is our opinion that the last word has not yet been said. —La Nature.

## THE "INDEX ANIMALIUM."

THE number of species of recent animals already described has been computed by our zoological recorders as 386,000; including fossils, we may well put the number at 550,000. The number of names applied to those animals is, however, far greater. Owing to the ignorance or perversity of men, or to the gradual advance of knowledge, some animals are burdened with as many as twenty names, but—unlike "the ways of constructing tribal lays"—only one of them is right. Now, whatever be the principles that guide a systematist in determining the name that should be applied to a known species, it is clear that he must have all the claimant names before him when making his decision; and not only the names that have been applied to the species in question, but names applied to other genera and species, some of which may have received identical names. Consequently, as we have often urged, a complete list of all names that have ever been proposed is an indispensable preliminary to any effective revision of nomenclature. Such a list is the "Index Animalium," now being prepared under the auspices of a committee of the British Association.

It has already been shown in Natural Science (Jan., 1896) that the average number of names applied to each species mentioned in the British Museum Catalogue of Birds is 5⅙. But on a more moderate estimate of three names to each known species in the animal kingdom, this index will have to contain no less than 1,650,000 references. The mere writing of these is almost a life's work; and to this labor must be added that of searching for scarce literature, or verifying dates—a most important part of the work—of interpreting obscure passages often in strange tongues, and of sorting

FIG. 3.—JAPANESE LADIES COLLECTING GLOW WORMS.
(REDUCTION OF A JAPANESE PRINT.)

the slips into alphabetical order under genera. To this gigantic task, Mr. C. Davis Sherborn, an enthusiastic and competent bibliographer, has devoted himself. In the course of some four years he has completed 140,000 references, each on a separate slip and in duplicate. These are arranged under genera as the work goes on, so that they are always available for reference. Any zoologist can see them by applying at the library of the Geological Department of the British Museum (Natural History), and in this way or through correspondence many have already derived important help from Mr. Sherborn's labors.

Descriptions of the methods and progress of the work have recently appeared in the Proceedings of the Zoological Society (1896, pp. 610-614) and the Geological Magazine (Dec. iv, vol. iii, pp. 557-561, Dec., 1896); but, feeling that zoologists in general are not sufficiently aware of the service being rendered them, the committee has asked us to draw attention to it. We do so with great pleasure, and we earnestly trust that some practical expression of sympathy may be the outcome. The British Association was able last year to make a grant of £100 toward the work; but this does not go far, and there is no guarantee that a repetition even of this will always be practicable. To make satisfactory progress, at least £200 a year is needed, and the zoologists and paleontologists of the world should surely be able to provide that sum.—Natural Science.

THE COLOBUS VELLEROSUS.

## THE COLOBUS VELLEROSUS.

OUR illustration shows a Colobus vellerosus, or silk monkey, as they are found in the territory between the Gold Coast and Dahomey, along the Gulf of Guinea. The colobi in general are remarkable for their long, silky fur, for the almost entire disappearance of the thumbs of the fore hands and for the tuft which they have on the end of their long tails. They are inhabitants of the virgin forests, where they live in companies on high trees, scarcely ever descending to the ground. They have a very clever way of hiding themselves in the foliage, by drawing together the branches beneath them. Commercially these colobi are of importance for their fur, which is imported into our civilized world, to be made into articles for winter clothing.

There are three varieties of colobi known. First there is the Colobus vellerosus, a specimen of which in the Hamburg Zoological Gardens has supplied the model for our illustration, taken from the Illustrirte Zeitung. The tuft on the end of the tail can be clearly distinguished. His cheeks are covered with a bushy white beard; the upper portion of his fore limbs is gray, all the rest of his body is black. His fur is long and silky all over. The monkey feeds on leaves, tender buds and shoots, and all sorts of fruit. A peculiarity of this particular colobus is that, when young, it is quite white, but it soon changes to the color of the adult.

A somewhat similar monkey, the Colobus ursinus, is found in Liberia and Sierra Leone. This variety has white shoulders. In the Congo State the Colobus satanas is the only representative of the class of colobi. He is, as his name implies, quite black. There are also olive colored colobi, which are characterized by a tuft of fur on their heads, and others colored variously from red to black and black and white.

## THE TRUE PURPOSE OF A LARGE PUBLIC PARK.*

THE true purpose of a large public park is to provide for the dwellers in cities convenient opportunity to enjoy beautiful natural scenery and to obtain occasional relief from the nervous strain due to the excessive artificiality of city life.

By large public park is not meant one covering more than a certain number of acres, but one large enough to contain a complete natural landscape, where the boundaries will not be obtrusive; where city conditions will not be unduly apparent; where one may stroll over hill and dale, across meadows and through woods, always amid natural surroundings, for hours, without twice following the same routes; where one may come again and again without becoming familiar with all its interesting localities and natural features; where many thousands of visitors may be enjoying the scenery at the same time without crowding each other; where those who especially seek seclusion may find parts so remote from the boundaries that even if city houses are not completely hidden they become reduced in the distant perspective to inconspicuous proportions as compared with the foliage of trees and other natural objects in the foreground; so remote that the roar of street traffic is less noticeable than the rustle of foliage stirred by the breeze or than the songs of birds and insects.

That the scenery of such a park should be beautiful no one will deny, but that it should be natural needs explanation. There can hardly be such a thing as absolutely natural scenery in a public park near a large city. Fires, pasturing, cultivation, wood chopping, the destruction or driving away of the wild animals, wild birds and insects, and the introduction of others, have long since ended purely natural conditions about every large city, leaving at best only a general resemblance to natural scenery. Even if a tract of land is still to be found in a comparatively natural condition while in private ownership, it could not remain entirely in that condition after being properly fitted for and used as a public park.

With these limitations in mind, what is meant by the natural scenery of a large public park may be itemized as ordinarily either open meadow, open grassy hillsides or rolling ground, open groves of trees with good turf, dense woods, borders of shrubbery, or low woody or herbaceous undergrowth, water in river, brook, pond or pool, and more rarely cliffs or ledges of rock. These principal features of the scenery again may be divided into their elements of earth or rock surface, water surface and foliage, either ground cover, shrubbery or trees.

In most cases a good deal of grading needs to be done in places. The original natural surface is wholly or partially destroyed and a new surface is created artificially, but it should be so shaped and finished as to appear natural, or, at least, as closely in harmony with natural surfaces as study and care can make it. Too often, however, through lack of appreciation of the true purpose of a large public park, the grading which must be done, either ignorantly or carelessly, or owing to mistaken ideas as to economy, or owing to personal preference for artificiality, is made as regular and unnatural as possible, so that what might have been done in harmony with the natural scenery antagonizes it and greatly lessens its value for its true purpose. Abundant instances of artificial-looking grading in the wrong place exist in many of our large public parks. The responsibility of park commissioners for this sort of interference with the true purpose of a large public park is generally only in the indirect way of intrusting the work to men not properly trained in park work or by enforcing an unwise economy; for it must be acknowledged that to grade naturally and gracefully usually costs more than to grade formally and stiffly.

The water surfaces of a park need more study and care to make them appear natural in outline and as to their margins than does the general ground surface of the park. Too often park waters are almost as stiff and formal in their outlines and in the shaping of their shores as are the curvilinear distributing reservoirs of waterworks. Here, again, the park commissioners are indirectly responsible for the bad results in consequence of working without the plans and directions of a trained artist or without a foreman trained in producing natural effects in park grading.

The verdure of a large public park is what the eye rests upon almost everywhere, and it is therefore the most important of the natural elements of the scenery. The almost universal ground cover is grass, since no other plant is so well adapted to the purpose of hiding bare earth while enduring, with due care and under sufficient restrictions, the trampling of great numbers of people. But there are places where even grass will not thrive, or where a wider or more varied effect is desirable. Such cases are very generally ignored in our large public parks, owing to a lack of knowledge or of artistic appreciation of the possibilities or requirements of particular cases. If gardeners studied natural scenery more, they would almost surely discover many opportunities in parks for the application of what they observed in the country. For instance, a dense natural wood which need not be or cannot be well thinned out sufficiently to permit a good turf to be grown, so that people may properly be allowed to ramble everywhere in it, may often be rendered far more natural and interesting by planting pretty wild flowers in its margins and suitable shrubbery undergrowth in its interior. Again, steep, open banks, where it is difficult and expensive, and often unnatural, to maintain turf, can be made far more interesting by the use of low ground covering plants or shrubbery.

Relief from the nervous strain of an artificial city life is afforded in no way so agreeably and conveniently as by a ramble amid the natural scenery of a large park and by the leisurely contemplation of the landscape. There are many workers in a city who suffer more or less from nervous strain, though often they are not fully aware of it. Where a large public park with ample provisions of natural scenery has been created, it has never failed to be much frequented for this purpose and to afford untold benefit to those who use it. Not only are the quiet and seclusion obtainable in the middle of a large area necessary in affording opportunities for occasional relief from the nervous stress of our artificial city life, but they are necessary to the enjoyment of the landscape of the park. Therefore, not only should conspicuous artificial objects unnecessary for the convenient use of the park be excluded from its natural parts, but noisy and dangerous occupations and amusements should also be kept out of at least the middle portions of a large park. In order to have the essential quality of seclusion, a large park should not be attempted on both sides of a railroad or important city street if it is possible to avoid it, for even if the landscape could be made to seem continuous across the gap, the noise would almost destroy the desired seclusion of a considerable part of it. An extent of natural scenery sufficient to afford the sense of quiet and seclusion so beneficial to the city worker can only be secured where the grounds are ample, and therefore this should be the essential characteristic of a large park. It is the one vital reason for the existence of such a park. No number of small parks can possibly answer the same purpose, however useful and even necessary they may be for other reasons.

Even if the true purpose of a large park has been kept in view during the process of selecting the land, determining upon its landscape features, designing its necessary construction and plantations, it is too often lost sight of subsequently, and there is a marked tendency to artificialize the landscape. But whenever it is thought wise for a municipality to provide special attractions, these should be limited in kind and number and be carefully devised. It would not be wise or economical for a city to destroy or injure broad and beautiful park scenery by introducing artificial attractions into it when these could perfectly well be provided in the smaller squares or in special amusement grounds, which could usually be much nearer the center of population than a large park, and therefore could be used by more people more frequently and more cheaply. It is customary for cities to provide for certain kinds of amusements which are healthful and innocent, and for certain objects that are instructive and entertaining and for some that are artistic and in-

* From a paper read before the recent meeting of the Park and Outdoor Association of Louisville, Kentucky, by John C. Olmsted, of Brookline, Massachusetts.—From Garden and Forest.

spiring, and which cannot be or are not usually supplied solely by private effort. Such, for instance, are formal gardens, statuary, conservatories, botanical and zoological gardens, concert groves, electric and other fountains, fireworks and the like; also popular athletic grounds, parade grounds, ball grounds for boys, and facilities for boating and bathing. From motives of expediency, it is customary to include arrangements for some of these purposes in large public parks, but they should be placed in their borders, and in such a way that they will do the least possible injury to the more secluded parts of the scenery. Great discrimination is necessary in selecting among these objects those which will least interfere with the primary purpose of a large public park. Those forms of amusement or instructive entertainment requiring large buildings or implying much noise, or which draw large and careless crowds that would be liable to injure the grass and shrubbery and trees of the park, should be excluded. It is good policy to secure suitable lands adjoining a large park which can be held in reserve as sites for public museums, grounds for parades, fireworks, public speaking, baseball and (by flooding in winter) for skating and so on. The park in Brooklyn is exceedingly fortunate in having two very commodious public grounds adjoining it. It is greatly to be desired that other cities should do likewise.

If there were a well established and clearly recognized custom controlling what artificial features might and what should not be introduced into large public parks, such customs would develop into rules of common law. Or if there had been carefully drawn and detailed statutes passed upon the subject, or if there had been a series of decisions of courts as to what buildings and other objects could legally be introduced into public parks, their true purpose would be more clearly understood. It is true, there has been for years a statute in New York State forbidding the erection of buildings above a certain size not strictly for park purposes in any public park, but the principle upon which this law is based is so little understood that a few generous individuals recently had no difficulty in getting a special law passed which enables them, with the consent of the park commissioners, to introduce a great museum of history into one of the most beautiful landscapes of one of the most perfect large public parks in the world. The usual arguments in support of this desecration have been urged, namely, that the building is for a worthy semi-public object; that the collection it is to contain will be interesting and instructive to the public, and that the building itself will be handsome, and consequently that it will be an ornament to the park. If this argument is sound for one such building, it is equally sound for others. In that case a large public park is little more than a tract of beautiful vacant building lots which the public is temporarily enjoying as a playground until it shall be gradually required for one public or semi-public building after another. If there is no principle upon which the advocates of the first semi-public building can be refused a site, there is no logical reason for refusing sites to any subsequent projects of a like sort. The bars once let down, there will be a stampede to secure beautiful building sites free of cost for natural history, art, botanical and other museums; for armories, normal colleges, high, grammar and primary schools, and so on almost indefinitely.

## MONAZITE.*

By H. B. C. Nitze, E.M., Chemist to the Wetherill Concentrating Company, South Bethlehem, Pa.

It has only been within the past few years that monazite has become one of the important economic mineral products, in its use for the manufacture of the incandescent mantles of the Welsbach light. Previous to that time it was considered one of the rare minerals, as denoted by its name, a derivation from the Greek, meaning "to be solitary."

The demand created by the manufacturers of the incandescent gas lights for the rare earth minerals stimulated the search for monazite, and it was soon found to exist in certain deposits and rocks, where its presence had not before been suspected, and so necessity became the mother of discovery.

Monazite is essentially a phosphate of the rare earths, cerium, lanthanum and didymium (Ce. La. Di.) $PO_4$. It also contains, almost always, small variable percentages of thoria ($ThO_2$) and silica ($SiO_2$), which by some are supposed to be present in combination, as an impurity, in the form of thorite or orangite ($Th.SiO_4.H_2O$), while others believe that the thoria is a primary constituent, present originally as the phosphate, either in combination with cerium or as an isomorphous compound, and afterward altered to the silicate by silicious waters.

Several typical analyses, made by Prof. S. L. Penfield,† of Yale University, are appended:

| | 1. | 2. | 3. | 4. |
|---|---|---|---|---|
| $P_2O_5$ | 28·18 | 29·28 | 26·12 | 29·32 |
| $Ce_2O_3$ | 33·54 | 31·38 | 29·89 | 37·26 |
| $La_2O_3$ | 28·33 | 30·88 | 26·66 | 31·60 |
| $ThO_2$ | 8·25 | 6·49 | 14·23 | 1·48 |
| $SiO_2$ | 1·67 | 1·40 | 2·85 | 0·32 |
| $H_2O$ | 0·37 | 0·20 | 0·67 | 0·17 |
| | 100·34 | 99·63 | 100·42 | 100·15 |

(1) From Portland, Conn.; (2) from Burke County, N. C.; (3) from Amelia County, Va.; (4) from Alexander County, N. C.

Monazite crystallizes in the monoclinic system. The usual crystal habit is tabular, parallel to the orthopinacoid ($\infty P\bar{\infty}$); also short columnar, and sometimes elongated in small needle-shaped crystals in the direction of the prism ($\infty P$). The crystals are usually well developed and free from distortion. They vary in size from microscopic needles, having a thickness of only 0·00015 to 0·00062 in., to the abnormally large and rare crystals that have been found in Amelia County, Va., 5 in. in length. The more usual size, however, lies between 0·05 and 1 in.

The cleavage is most perfectly developed parallel to the basal pinacoid (oP); it is also distinct, as a rule, parallel to the orthopinacoid ($\infty P\bar{\infty}$), and sometimes parallel to the clinopinacoid ($\infty P\grave{\infty}$).

The mineral is brittle, with a conchoidal to uneven fracture.

The hardness is 5 to 5·5. The specific gravity varies from 4·6 to 5·3. The luster is resinous to waxy, and the crystal faces are splendent in the fresh, pure specimens, and dull in the weathered, impure specimens, the surfaces being sometimes coated with a light brown earthy substance, probably an alteration product.

The purest specimens are transparent, becoming translucent and even totally opaque in the impure varieties.

The color is honey yellow, amber yellow, yellowish brown, reddish brown and sometimes greenish yellow.

Monazite is an accessory constituent of the granitic rocks and their derived gneisses. It has been found in these rocks over widely separated regions of the earth's surface, and further search and study is liable to reveal its probable universal presence in most granites and gneisses. It has also been found in apatite, cyanite, and even in vein quartz. The main constituents of the granitic rocks (quartz, feldspar and mica) all contain the monazite as intergrowths, though it appears to be more generally confined to the feldspar. Zircon may be regarded as a constant accessory, and among the other usually associated minerals may be mentioned garnet, rutile, ilmenite, magnetite, xenotime, fergusonite, gadolinite, sphene, cassiterite, corundum, etc.

Monazite has not been found in the sedimentary rocks, although it may be present in some of these as a re-deposited mineral.

The economically valuable deposits are found in the placer sands of streams and rivers, in the irregular sedimentary sand deposits of old stream beds and bottoms, now covered up, and in the beach sand deposits along certain seashores.

In the southern unglaciated countries the decomposition and disintegration of the crystalline rocks, the original source of the mineral, have proceeded to considerable depths. By erosion and secular movement the loose material is deposited in the stream beds, where it undergoes a natural process of sorting and concentration, the heavy minerals, and among them the monazite, being deposited first and together. The richer portions of these stream deposits are therefore found near the head waters.

The beach sand deposits have a similar explanation, the concentration in this case being brought about by the action of the waves.

The geographical areas over which such workable deposits have been found up to the present time are quite limited in number and extent. In the United States the placer deposits of North and South Carolina stand alone. This area comprises about 2,000 square miles, situated in Burke, McDowell, Rutherford, Cleveland and Polk Counties, North Carolina; and Spartanburg, Greenville and York Counties, South Carolina.

The country rocks are granitic biotite gneiss and dioritic hornblende gneiss. Most of the stream deposits have been worked for gold. The thickness of the gravel beds is from 1 to 2 ft. and the width of the mountain streams in which they occur is seldom over 12 ft. The percentage of monazite in the gravel is very variable, from an infinitesimal quantity up to 1 or 2 per cent.

In Brazil extensive deposits of monazite occur in the beach sands along the sea coast. The largest of these is on the island Alcobaca, in the extreme southern part of the province Bahia.

Deposits are also found in the gold and diamond placers of the provinces Bahia (at Salabro and Caravellas), Minas Geraes (at Diamantia), Rio de Janeiro and Sao Paulo.

In the United States of Colombia deposits of importance are reported in the gold placers of the Rio Chico, at Antioquia.

In Russia the mineral is found in the Bakakui placers of the Sanarka River in the Ural Mountains; also in the placer mines of Siberia.

In North and South Carolina the monazite is won by washing the sand and gravel in sluice boxes with a stream of water, exactly after the manner that placer gold is worked. The sluice boxes are generally about 8 ft. long by 20 in. wide by 20 in. deep. Two men work at a box, the one charging the gravel on a perforated plate fixed in the upper end of the box, the other one working the contents up and down with a gravel fork or a perforated shovel in order to float off the lighter sands. The boxes are cleaned out periodically, depending on the richness of the gravel and the consequent degree of accumulation of the concentrated monazite. From 40 to 70 pounds of cleaned monazite per box is considered a good day's work.

Sometimes two or more boxes are used, arranged in a series of steps, one below the other.

Magnetite, if present, is eliminated from the dried sand by treatment with a large hand magnet. Many of the heavy minerals, such as zircon, garnet, rutile, ilmenite, etc., cannot possibly be completely eliminated by any means of water separation, owing to the slight differences of their specific gravities.

The commercially prepared sand, therefore, after washing, is not absolutely pure monazite. A sand containing 65 to 70 per cent. monazite is considered a good quality.

Some operators endeavor to clean the water-concentrated sand still further, by pouring it, after it is dried, from a small spout situated in the bottom of a hopper, in a fine steady stream from a height of about four feet on a level platform; the lighter particles (quartz, feldspar, etc.) together with the finer grains of monazite, garnet, rutile, etc. (which might be called tailings), fall on the periphery of the conical pile, and are constantly brushed aside with hand brushes; the tailings are afterward rewashed. Instead of pouring and brushing, the material is sometimes treated in a winnowing machine similar to that used in separating chaff from wheat.

Although the grade of the sand may in this way be brought up to eighty-five per cent. pure, the quantitative proportion is small as compared with the second and other inferior grades, and there is always a considerable loss of monazite in the various tailings.

It is impossible to conduct this washing operation without loss of monazite, and equally impossible to make a perfect separation of the garnet, rutile, ilmenite, etc., even in the best grades. The additional cost of such re-treatment and re-handling must also be taken into consideration.

A marked improvement in the economy and perfection of the treatment would be to size the raw material, separate the quartz and lighter minerals by jigging, and subsequently separate the heavy minerals, garnet, rutile, etc., in the jig concentrates, by passing over a Wetherill magnetic separator.* Experimenting in this direction, I have succeeded in making a practically perfectly clean monazite product, with but an insignificant loss in the tailings.

If the raw material contains gold, it will be collected in the sluice boxes or in the jig concentrates, and it may frequently pay to separate it, which can be readily accomplished by treating the wet concentrates in a riffle box with quicksilver.

The monazite in the stream beds of the Carolina fields has been practically exhausted, and the last mining operations were carried on, for the most part, in the old gravel deposits and channels of the adjoining bottom lands. These deposits are mined by sinking pits, about eight feet square, to the bed rock, and raising the gravel by hand labor to sluice boxes above. The over-lay, which may vary from three to five feet in thickness, is thrown away, excepting in cases where it carries any sandy or gritty material. The pits are carried forward in parallel lines, separated by narrow tailing banks, similar to the method pursued in placer gold mining.

It has been shown that the monazite occurs in place as an accessory constituent of the country rocks, and that the latter are decomposed to considerable depths, sometimes as much as 100 feet. However, on account of the minute percentage of monazite in the mother rock, it is usually impracticable to economically work it for monazite alone, by such a process as hydraulicking and sluicing, for instance. Where the decomposed rock is gold bearing, and this is sometimes the case, it may pay to recover the monazite as a by-product. In certain instances the decomposed gneiss, in situ, has been found sufficiently rich in monazite to warrant working it.

The value of monazite depends on its percentage of thoria, as this is the element mostly sought after by the incandescent light manufacturers. And, as the percentage of thoria is variable in different sands, the value of the sands is consequently also variable.

The only method for determining the percentage of thoria is by chemical analysis. The fluctuation of the thoria is considerable even in the same locality. It also depends, of course, in a measure, on the degree of concentration of the sand. Some monazite contains practically no thoria. The best Carolina grades carry from four to seven per cent.

The price of Carolina monazite has varied from twenty-five cents per pound in 1887 to as low as three cents for inferior grades and six to ten cents for the best grades in 1894 and 1895. In 1896, the price fell so far below this mark as to render the mining unprofitable and practically cripple the industry. This was owing to the development and increased output of the Brazilian field, where the sand occurs naturally concentrated on the beach, and requires no cleaning treatment for shipping, after it is dug out. Being loaded directly into the ships' holds as ballast and transported by water, the freight costs are also considerably less.

In 1893, the output of Carolina monazite sand was 130,000 pounds; in 1894, 546,855 pounds; in 1895, 1,900,000 pounds; and in 1896, for reasons above named, it fell to 17,500 pounds.

* This paper embodies the results, in somewhat condensed and rearranged form, of previous communications by myself, which have appeared in the Sixteenth Annual Report of the United States Geological Survey, 1894-95, Part IV, and in Bulletin No. 3 of the North Carolina Geological Survey, 1896.

† See American Journal Science, vol. xxiv, 1882, p. 250, and vol. xxxvi, 1888, p. 322.

* See Jour. Frank. Inst., 143, 379.

## RECENT ARCHÆOLOGICAL DISCOVERIES IN THE NILE VALLEY.

M. Jacques de Morgan, the director-general of antiquities of the Egyptian government, has just forwarded to his brother, M. Henri de Morgan, of this city, particulars of his latest find in the ancient Nile Valley. The letters tell of one of the greatest Egyptian discoveries that have ever been made. They describe the finding of the tomb and mummified body of Egypt's probable first king, who is supposed to have reigned 4800 B. C., or almost seven thousand years ago. According to archæologists, the importance of this discovery cannot be overestimated. M. de Morgan is one of the greatest Egyptian explorers. Many finds of inestimable value can also be placed to his credit, and a large portion of the contents of the imperial museum of antiquities at Gizeh evidences his success in ancient Egyptian discoveries. During the greater part of last year he paid special attention to the study of prehistoric man in the Nile Valley; and in that portion of the valley formed by the bend in the Nile between Thebes and Abydos he unearthed many of the oldest records pertaining to early Egyptian history that have yet been found. From these records it became apparent that at one time, in the extremely remote past, Abydos was the capital of Egypt and the city that contained the tomb of Osiris, the oldest tomb of which tradition speaks. It was to investigate over again this remarkable ground that M. de Morgan began his search. Working steadily by means of trenches and soundings, the first notable discovery was made in the shape of ancient flint arrow heads. These were of the most remarkable kind, and evidently belonged to a period considerably antedating the time of the fourth dynasty, which up to this time had been the most remote age of which science had any record. Other implements were found in the shape of indented flint blades, which had probably been used as saws and sickles. This was determined from the fact that wheat is believed by historians to have grown wild in Egypt at the time of the first dynasty, and the shape of the implements found indicates clearly that they were used for harvesting this wild cereal. A complete specimen of one of these sickles, in its wooden setting, was found deeply buried in the sand. This sickle indicates that the people of the first dynasty were advanced in the art of agriculture, as well as accustomed to the use of flint tools.

M. de Morgan also found evidences that these ancient people had a religion of their own, in the shape of slate figures of fishes, birds and turtles, which he dug up. He believes the religion to have been a sort of fetishism, as he can in no other way explain the curious images. Regarding this point he says: "These figurines must have belonged to either the first dynas-

ty or to a race and period preceding it, as I have found them only in these autochthon places. Of this fact there is no doubt, as the figurines were unearthed under my own eyes, and I must add that not in any of the other old tombs of the ancient empire that have been discovered have I ever found the slightest fragment." Continuing his soundings and study of the ground, M. de Morgan slowly made his way along the valley until he reached a point near Negada, where an extraordinary mound attracted his attention. So out of the usual nature of the ground was it that he determined upon an investigation. Excavations were begun at the base of the north side of the mound and revealed the existence of a huge quadrangular shaped tomb. As soon as this discovery was made a camp was established and work commenced in earnest. Numerous attempts were made to pierce the solid sides of the tomb, which from the nature of the surroundings, the explorers believed to be intact. Finally, on one side an opening was made, which was gradually enlarged to the size of a large doorway. Long, gloomy passageways descended down into subterranean depths. They passed through the rows of wonderfully carved columns, down the hollow passageway, to the caverns below. From top to bottom the walls were covered with hieroglyphic inscriptions, and cut deeply into the surfaces were outlined the figures of men and animals that had lived and died five thousand years before the Saviour walked the earth. Strange characters of warriors, different from anything seen in other tombs, stood out in bass-relief, and the images of children, kneeling as if in fear, appeared here and there on the sides of the passageways.

Taking the main aisle, they followed it by torchlight, and found that it led into a series of rooms. In all there were twenty-one of these rooms, each containing many objects. In the center of each were placed sarcophagi containing the mummified remains of the dead, and around them were scattered many objects of the utmost antiquity. There were a number of pieces of what had once been furniture, in several different designs, and here and there fragments of bronze statues lay in the dust. In almost every one of the rooms a quantity of broken vases was found. These bore evidences of having been made of alabaster or some similar stone, and were of the most peculiar and wonderful designs. Still other vessels were found cut out of the hardest materials, such as rock crystal and quartz. How these remarkable people managed to cut such hard substances, or the methods and tools they had for doing it, is a mystery. There were a number of implements found in several of the rooms, but they were all of flint. It is nevertheless evident that they must have possessed some other instrument, harder even than flint, to have been able to make such carvings. Several vessels made from a substance resembling obsidian were also found. From one room to another the explorers went until they discovered a large central room. In the center, upon a pedestal of solid rock, rested a single huge sarcophagus. Around it, rudely carved in ivory, were the forms of fishes and dogs in strange and grotesque shape. Near the feet were the remains of what appeared to have been a mammoth lion, made of countless pieces of ivory mysteriously put together. The sides of the room were covered with inscriptions of a period so remote that interpretation was impossible. At the head of the great sarcophagus and facing it was the life size statue of a man carved in wood. The explorers then opened the sarcophagus and exposed to view the inner mummy case, which was covered with hieroglyphics. So important was this discovery that no attempt was made to open the mummy case for fear the body, coming in contact with the air after being sealed up for so many centuries, would at once crumble into dust. The sarcophagus was again closed and sealed, after which it was prepared for removal to the museum at Gizeh, where the body will be carefully unwrapped.

Attention was then devoted to the sarcophagi in the other rooms, all of which were supposed to contain the bodies of royal persons. These have also been removed to the museum, where they will be opened. M. de Morgan then began the removal of the various articles from each of the rooms. In all of them he found large urns tightly closed and having on the top what is known as a "banner name," or the seal of the king. The presence of these "banner names" is regarded by archæologists as conclusive proof of the great antiquity of the tomb. The large wooden statue in the king's chamber was next studied. It was finely proportioned and was placed at the head of the sarcophagus in order to provide a resting place for the king's soul in case anything happened to injure the body. M. de Morgan says that the rulers of these early dynasties deemed it absolutely essential that their bodies should exist in a perfect condition until the time of the corporeal resurrection of the royal dead. According to their belief, the living man consisted of four parts—a body, a soul, an intelligence, and an appearance, or double. Death disassociated these four parts, which, according to the belief, would ultimately be reunited for all time. If upon the return of the soul the real body was in any way injured, the soul immediately took refuge in the wooden image. The inscription on the walls of this wonderful tomb, like those of a later date, pictured the achievements and elaborate funeral rites and texts of the royal inhabitant. They showed him in the height of his glory and again lying in mummified form. A series of pictures represented the body being conveyed on a great sledge across a sacred valley to the tomb. The sledge was drawn by oxen and men and followed by many mourners. The pictures indicated that at that period of the world's early history the greatest ceremony of a king's life was his funeral, and the ceremony must have extended over a great many days, judging from the gorgeous rites that were performed. The ceilings of all the passageways and rooms in the great tomb were lined with what appeared to be sun-dried brick, although the bricks were of very coarse workmanship. The pavements of the floors were of granite, and here and there were traces of wooden coverings. Until this discovery by M. de Morgan, nothing had been found to throw any light upon the beginning of Egyptian history.—The New York Herald.

**A bronze** statue of Marcello Malpighi has been erected at Crevalcore, near Bologna. The Royal Society sent an address of congratulation, Malpighi having contributed many valuable papers to their Transactions.

## THE DANGER IN VEILED STIMULANTS.

THE medical profession and the laity have been accustomed for so many years to the abuse of alcohol as a nervous stimulant that some persons have become hardened to the miseries which it induces, while others have been stimulated to its excessive condemnation. As a result of this and of the general desire for stimulating foods or drugs, a very large number of persons have been led to place before the public other powerful nervous stimulants, of which both the medical profession and the laity know less than they know of alcohol, until at the present time there are almost as many consumers of nervous stimulants other than alcohol as there are of those who use alcohol to excess. Further than this, the number of these substitutes is daily increasing, and in many instances unprincipled venders are fortifying comparatively innocent and mild nervous stimulants, dispensed for common use, with so large a quantity of alcohol added that the patient really becomes addicted to the alcohol habit. The object of this is not, however, to direct attention to these preparations or to the evil effects which they produce, but rather to make clear the fact that all of them are but temporary makeshifts which in the end, in the vast majority of cases, materially increase the discomfort and the ill health of the person who takes them.

The abuse of these remedies by the profession is not so much the result of ignorance as of carelessness. There is no drug yet discovered, so far as we know, unless it be alcohol, which distinctly adds force to the body when it is taken. All of the so-called "strengthening remedies," which enable a man to accomplish more work when he is under their influence, do this, not by adding units of force to his body, but by utilizing those units of force which he has already obtained and stored away as reserve force by the digestion of his food. Kola, coca, excessive quantities of coffee and tea, and similar substances, while they temporarily cause nervous work to seem lighter, only do so by adding to the units of force which a man ought to spend in his daily life those units which he should most sacredly preserve as a reserve fund. The condition of the individual who uses these remedies when tired and exhausted, with the object of accomplishing more work than his fatigued system could otherwise endure, is similar to that of a banker who, under the pressure of financial difficulties, draws upon his capital and reserve funds to supplement the use of those moneys which he can properly employ in carrying on his business. The result in both instances is the same. In a greater or less time the banker or the patient, as the case may be, finds that his reserve fund has disappeared and that he is a pecuniary or nervous bankrupt.

Even the advertising boards and fences of the cities, towns and country now contain advertisements which mislead the ignorant into the idea that, by using the drugs named thereon, they will actually increase the development of their muscular power, when in reality the final result of such a course must be to decrease the nervous stamina which the would-be athlete so earnestly desires.—Therapeutic Gazette.

## THE ETIOLOGY OF YELLOW FEVER.

E. KLEIN, in Nature.

YELLOW fever is an acute infectious disease, endemic in the West Indies, the shores of the Mexican Gulf, and in some parts on the west coast of Africa, whence the disease has been repeatedly transported into other localities, causing epidemic outbreaks. Like other infectious diseases, yellow fever is supposed to be caused by a specific living entity which, invading a predisposed person, multiplies there and causes the peculiar pathological changes in the gastro-intestinal tract and the liver characterizing yellow fever. Within recent years the supposed specific microbe has been discovered several times. Dr. Domingos Freire, of Brazil, and Dr. Carmona y Valle, of Mexico, have announced such discovery, but Dr. Sternberg, of Washington, who has himself studied the disease on behalf of the United States government, has shown that none of these discoveries is a reality, and after a prolonged investigation, including the examination of a great many cases affected with or dead from the disease, has arrived at the following conclusions, embodied in a lengthy report to his government: that none of the different species of bacilli and cocci, present in the intestinal canal, in the blood, the liver and other tissues of persons affected with yellow fever, can have a claim to be considered as the specific microbe; that in a number of cases the examination, microscopic and cultural, of the blood and tissues yielded no bacteria recognizable either by the known methods of staining or culture; and he finally implied that the specific microbe of yellow fever is most probably not of the nature of a bacterium at all. After these very definite conclusions by Dr. Sternberg, it came rather as a surprise when, some months ago, the announcement was made that Dr. Sanarelli, Professor of Experimental Hygiene in Montevideo, formerly in the Pasteur Institute in Paris, had discovered the true cause of yellow fever in the form of a bacillus, Bacillus icteroides. This surprise is still further heightened by the statement in Dr. Sanarelli's lecture, that the Bacillus icteroides is demonstrable by the ordinary methods of staining and by culture in the ordinary well-known media. The morphological and cultural characters of the bacillus show it to belong to the group of coli-like bacilli; it is rarely demonstrable in a pure state in the blood or tissues, being generally associated with a more or less copious admixture of other microbes—Bacillus coli communis, streptococci and staphylococci; as a rule it is present only in small numbers in the capillary blood vessels of the liver, spleen and kidney. It reflects great credit on the perseverance and sagacity of Dr. Sanarelli to have been able, notwithstanding all these difficulties, to select out the Bacillus icteroides, and to have by animal experiment been able to demonstrate, at least, as highly probable that the Bacillus icteroides is the true microbe of yellow fever. As mentioned just now, the distribution of the microbe in the affected person, its morphological and cultural characters, do not in themselves offer strong prima facie evidence, and Dr. Sanarelli himself fully recognizes this; but when we come to the experimental evidence which he furnishes, the evidence as to the Bacillus icteroides being the specific cause of yellow fever assumes considerable power.

In the first place, Sanarelli shows that dogs, goats and horses are susceptible to infection both with the living bacilli as also and particularly with the highly poisonous toxin produced by the bacilli in broth culture; the symptoms and anatomical lesions hereby produced in these animals in the intestinal tract, the liver and the kidney, bear a striking resemblance to those of yellow fever in man. In the second place, Sanarelli furnishes proof that the toxin produced in broth culture—and separated from the bacillary growth by filtration through a Chamberland filter—when injected into healthy persons causes a prompt reaction in the form of severe disturbance, primarily of the intestinal tract, but also, further, of the general system closely resembling that in yellow fever. It is to be hoped, nay, it may be assumed as certain, that in continuing his investigations Dr. Sanarelli will ascertain the action of the blood of human beings, who have passed through and recovered from the disease, on the Bacillus icteroides. This disease, as is well known, very rarely occurs twice in the same person, and it is therefore highly probable that, as is the case in other similar infectious diseases, the blood after a single attack possesses agglutinating action (in vitro), or germicidal action (in corpore), or both on the culture of the specific microbe. If on further investigation the blood serum, after an attack of yellow fever, should be found to show such positive actions on the Bacillus icteroides, a strong support will thereby be furnished as to this bacillus being the specific microbe. It will be the crowning of prolonged and laborious studies if Sanarelli by experiments on immunization of animals—the horse being evidently well fitted for such immunization—did, as is highly probable that he will, obtain antitoxic serum by which yellow fever can be successfully combated both prophylactically and therapeutically.

## ORIGIN OF FAT IN THE BODY.

THE subject of the origin of fat has once more been taken up by the experimentalist. Many years have now elapsed since the well-known French chemists, MM. Dumas and Boussingault, as the outcome of their researches, maintained that animals, whether herbivorous or carnivorous, were supplied with all their proximate principles by the vegetable kingdom—the former class directly, the latter indirectly through the herbivora on which they preyed. Animals, according to these observers, did not make fat, sugar or albumen, but derived each and all of these substances from plants. This position was contested by Liebig, who contended in regard to fat that this was not altogether obtained by animals from the fat of their food. On the contrary, they were able to make it with either sugar or starch. He pointed out, as Huber had done before him, that bees fed on sugar or honey alone were capable of forming fat in the form of wax, but Huber had omitted to weigh the bees before dieting them, and Dumas and Boussingault ingeniously argued that the wax formed on a diet of pure farina or sugar was originally stored up in the bodies of the bees and utilized by them in the construction of their combs. Liebig therefore still supported the view of Huber, and held that the greater part of the fat which is deposited in the animal body and that which is found in the milk of nursing mothers is formed in the body and almost exclusively from the hydrocarbonaceous compounds of the food. The albuminoids, he thought, played quite a subordinate role from this point of view, as, indeed, seemed probable when it was considered that the food of the herbivora which store up much fat is chiefly composed of carbohydrates, while the bodies of the carnivora, whose food is chiefly albuminous, contain little or no fat. Moreover, he experimented on a goose, which from a lean condition was fattened to such an extent that three pounds of fat was obtained from it, although the maize with which it had been fed did not contain anything like that quantity of fat. Dumas and Boussingault returned to the charge by making a careful analysis of the food given to a cow for a year and determining the quantity of fat which the animal yielded in the milk. They found the fat introduced with the food to be considerably in excess of that eliminated by the milk, but Liebig scored a point by observing that nearly all the fat ingested with the food escaped undigested from the bowels in the feces. Subsequent experiments, especially those of Lawes and Gilbert, on the herbivora clearly demonstrated that one, at least, of the sources of fat is the farinaceous material ingested. In the meanwhile various circumstances had led some investigators to adopt the view that the albuminoid or nitrogenous constituents of the food might play a part in the generation of fat.

Thus it was found that animals fattened best when their food, if chiefly farinaceous, was mingled with some albuminous compounds; while Pettenkofer and Voit demonstrated that in a dog freely supplied with flesh the whole of the nitrogen thus introduced into the economy was recoverable from the urine and feces, while the carbon remained in the economy and hence, probably, formed or aided in the formation of fat. The observations of Kemmerich on nursing bitches, of Subbotin of feeding dogs with palm oil and meat, of Hofmann on larvæ fed on defibrinated blood containing a known quantity of fat, all pointed in the same direction and led Voit to maintain, first, that the fat of animals is exclusively formed from the proteid aliments, and secondly, that hydrocarbonaceous compounds are not converted into fat in the animal organism, but simply preserve from oxidation the fat formed from the proteids. The latest researches on this point, however, are not quite in accordance with Voit's views. The most recent observer, Dr. Kaufman, arrives at the following conclusions: The proteids, in common with the ternary compounds of the food, contribute to the formation of fat, but, contrary to Voit's statement, they are not the exclusive origin of it. When, during digestion, a large quantity of proteids is absorbed it rapidly undergoes disintegration and forms fat. This fat has, speaking generally, three applications. One part oxidizes and, passing through the phase of glucose, supplies the requisite energy for the general physiological work of the organism; another part undergoes incomplete oxidation and is transformed into carbohydrate which is stored up in reserve as glycogen; while the third part remains intact and is deposited as fat. The proportion of fat which is fixed during the digestion

period varies with the abundance of the repast and the richness of the organism in glycogen. If the animal is poor in glycogen, it may happen that the whole of the nox-oxidized fat may be converted into glycogen. Calorimetric investigations demonstrate that if the anerobic decomposition of albumen really occurs, the process is not attended with any disengagement of heat.—Lancet.

## THE SKIN AS A DIAGNOSTIC FACTOR IN DISEASE.*

THE design of this paper is to deal with the conditions in which the state of the skin is liable to mislead the physician as to the cause of the illness of the patient. Sometimes, too, we are too much inclined to treat the skin affection as the only lesion of importance, and fail to connect it with the underlying condition of the system which is largely responsible for its development. These underlying provoking or predisposing agents are exceedingly numerous, and are perhaps best summed up or described in a very original manner by Dr. Stephen Mackenzie as follows: The seven stages of man could be well illustrated by diseases of the skin, though we lack a Shakespeare to do justice to the theme. In the "mewling and puking" infant we meet with sclerema and edema neonatorum, the "red gum" or strophulus of the older writers, intertrigo, eczema, urticaria papillosa (lichen urticatus), urticaria pigmentosa, xeroderma pigmentosum, and impetigo; "the schoolboy," with his chilblains and ringworm, alopecia areata, pityriasis rosea, ecthyma, and "football disease;" and then the "lover," with his acne and sycosis; and then the justice, with acne rosacea, diabetic boils, and pruritus ani; the sixth stage shifts into the "lean and slippered pantaloon," with rodent ulcer and "gouty" eczema; "last scene of all, sans teeth, sans eyes, sans taste, sans everything"—except an incessant and intolerable itching of the skin which we call senile prurigo.

Aside from these dermal manifestations of systemic states I believe that too little importance is given to the very common lesions of the skin following the use of drugs. The moment we leave the cases in which the eruption seems to arise without apparent cause, and approach the question as to the eruptions which may be produced by drugs, we pass into an almost limitless field. Only a few of the moderately common accidental rashes can be considered in the short space that can be devoted to this paper. As a rule, we are apt to regard iodoform as a very innocent substance, rarely producing untoward effects unless its application is exceedingly free, and then causing only general systemic symptoms of poisoning rather than skin manifestations. Usually this iodoformic rash appears when the drug is freely applied over a large surface, coming out generally within a few hours after the iodoform is applied (Meunier) and rarely after the twelfth day (Taylor).

It is a well-known fact to many more physicians than those who know of iodoform rashes that quinine is very apt in certain persons to produce skin eruptions of all kinds and varieties. In France, articles by Grellety, Dumas, and theses by Bouvard de Grissac and Levassor have recorded many cases, and a very large number of Americans have done likewise. Guirard states that in most cases, simultaneously with the ordinary symptoms of cinchonism, we have developed a roseola, a simple erythema, or a marked scarlatinal erythema. In other cases an acute eczema or urticaria comes on. I have seen this so-called quinine rash more than once. Usually the eruption is widely diffused, but, if limited, it may be found only about the breastbone or groin. If the eruption appears on the face, it is usually a tumefaction or edema. Its development is rapid and it soon reaches its greatest intensity, rarely persisting more than seven or eight days after the drug is stopped. Desquamation nearly always occurs. A differential point of value is that the eruption appears a second time if another dose is given.

Opium, on the other hand, is not usually suspected of causing eruptions on the skin. As a rule, the eruptions produced by it are limited to the face, but sometimes they are generalized. More commonly they are true erythemata and sometimes scarlatinal in type. In some cases there may be great redness of the skin, abundant sweating, acceleration of the pulse, heat of the skin. According to Brugisser, these symptoms often ensue after small doses, such as ten drops of laudanum. Finally we may discuss the skin lesions produced by turpentine. These follow both its internal and external use. As long ago as 1824 Barbière, in his work on "Materia Medica," and in 1841 Galtier, in a similar volume, described the onset of erythematous rashes, vesicles, and papules of very fleeting character after the ingestion of turpentine. Trousseau and Pidoux, in their book on "Therapeutics," have done likewise, but all these occurred after large amounts of the drug had been used or after its external employment. In 1879, however, Cordes published an early case of true turpentine rash following its internal use. In this instance a patient of thirty-four years, after the ingestion of turpentine, developed an erythema over the skin of the trunk. Another case observed by the same author was that of a woman who developed a marked urticaria under similar circumstances. In both these cases the eruption was very fleeting in duration.

The conclusions reached by Guirard are as follows: that medicinal eruptions are commonly limited to the face, afterward extending to the trunk symmetrically, and usually developing suddenly, as does erysipelas. Unless they arise from very large doses, they generally develop without being associated with general systemic symptoms. He thinks that the absence of these symptoms aids us in separating these cases from the infectious diseases. The eruptions due to drugs often change from one type to another, particularly those due to the balsams. The eruptions are usually sudden in onset and develop rapidly.

---

**The word** temper, as used in steel manufacture, means the percentage of carbon which the metal contains. For instance, in steel of razor temper, there is 1½ per cent. carbon; saw file temper, 1⅜ per cent. carbon; tool temper, 1¼ per cent.; spindle temper, 1⅛ per cent.; chisel temper, 1 per cent.; set temper, ⅞ per cent.; and die temper, ¾ per cent. of carbon.

* H. A. Hare, M.D., in the Medical Record, New York. Condensed for Public Opinion.




THE
# Scientific American Supplement.

**PUBLISHED WEEKLY.**

**Terms of Subscription, $5 a Year.**

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

**MUNN & CO., Publishers,**
**361 Broadway, New York, N. Y.**


## TABLE OF CONTENTS.

397.

ent.

in any
llars a

om the
Price,

n like-
yearly.
$3.50

MERI-
PPLE-

s, and

. Y.

PAGE
18190
18184
18196
18193
18190
18193
18187
18187
18188
18198
18197
18197
18197
18184
18186
18189
18189
18189
18195
18195
18194
18194
18190

umé
ingle
For-

an-
NT
be

N

to

ly

a